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RESTRICTED—Security Information

DEPARTMENT OF THE ARMY
TECHNICAL MANUAL
DEPARTMENT OF THE AIR
FORCE TECHNICAL MANUAL

TM 9-804A
TO 19-75AA-98

Regraded UNCL...

¼-TON 4 x 4
UTILITY TRUCK
M38A1

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
JULY 1952

RESTRICTED

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TM 9-804A/TO 19-75AA-98

¼-TON 4 x 4 UTILITY TRUCK M38A1

United States Government Printing Office
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This manual is correct to 25 June 1952

DEPARTMENTS OF THE
ARMY AND THE AIR FORCE
WASHINGTON 25, D. C., *21 July 1952*

TM 9–804A/TO 19–75AA–98 is published for the information and guidance of all concerned.

[AG 451.2 (3 Jul 52)]

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CONTENTS

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for the information and guidance of the personnel to whom this matériel is issued. They contain information on the operation and organizational maintenance of the matériel as well as descriptions of major units and their functions in relation to other components of the matériel.

b. The appendix contains a list of current references, including supply catalogs, forms, technical manuals, and other available publications applicable to the matériel.

c. This first edition manual is published in advance of complete technical review. Any errors or omissions will be brought to the attention of the Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM-Pub.

2. Organizational Maintenance Allocation

In general, the prescribed organizational maintenance responsibilities will apply as reflected in the allocation of tools and spare parts in the appropriate columns of the currents ORD 7 supply catalog (if available) pertaining to this vehicle and in accordance with the extent of disassembly prescribed in this manual for the purpose of cleaning, lubricating, or replacing authorized spare parts. In all cases where the nature of repair, modification, or adjustment is beyond the scope or facilities of the using organization, the supporting ordnance maintenance unit should be informed in order that trained personnel with suitable tools and equipment may be provided or other proper instructions issued.

Note.—The replacement of certain assemblies, that is engine, transmission, transfer, front axle, and rear axle normally ordnance maintenance operations, may be porformed in an emergency by the using organization, provided approval for performing these replacements is obtained from the supporting ordnance officer. A replacement assembly, any tools needed for the operation which are not carried by the using organization, any necessary special instructions regarding associated accessories, etc., may be obtained from the supporting ordnance maintenance unit.

3. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the quantity, and condition of matériel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of matériel in the hands of troops and for delivery of matériel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the matériel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to units operating and maintaining these vehicles are listed in the appendix. No forms other than those approved for the Department of the Army will be used. For a current and complete listing of all forms, refer to current SR 310–20–6.

c. Field Report of Accidents. The reports necessary to comply with requirements of the Army safety program are prescribed in detail in the SR 385–10–40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to matériel occur.

d. Report of Unsatisfactory Equipment or Materials. Any suggestions for improvement in design and maintenance of equipment, safety and efficiency of operation, or pertaining to the application of prescribed petroleum fuels, lubricants, and/or preserving material, will be reported through technical channels, as prescribed in SR 700–45–5, to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM, using DA Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged in order that other organizations may benefit.

Note.—Do not report all failures that occur. Report only REPEATED or RECURRENT failures or malfunctions which indicate unsatisfactory design or material. Hewever, reports will always be made in the event that exceptionally costly equipment is involved. See also SR 700–45–5 and printed instructions on DA Form 468.

Section II. DESCRIPTION AND DATA

4. Description

a. General. The truck described in this manual is designated as $\frac{1}{4}$-ton 4 x 4 utility truck M38A1. The vehicle is equipped with one front driving axle and one rear driving rear axle, with four driving wheels. The design of this truck locates the four-cylinder gasoline engine forward of the passenger compartment under the hood and provides a four passenger, open-type body. This body can be inclosed with removable canvas top, side curtains, and door held in place and supported by suitable metal rods and braces, and canvas straps. Provision is also made for the installation of a metal top. The utility truck M38A1 is used as a general purpose personnel or cargo carrier especially designed for adaptation to general reconnaissance, command communications, or other special duties. The design and construction of the windshield is so that it can be folded forward to lie flat on the hood for low silhouette and forward firing. The spare wheel and tire are mounted on the rear panel and suitable brackets and compartments are incorporated in and on the body for the carrying of equipment. The frame is equipped with a pintle hook at the rear and lifting hooks at the front and rear to permit towing or lifting vehicle. General physical characteristics of the $\frac{1}{4}$-ton 4 x 4 utility truck M38A1 are shown in figures 1 through 3.

b. Engine (figs. 42 and 43). Power for the utility truck M38A1 is supplied by an F-head type, four-cylinder, gasoline, Willys Overland engine. This type engine is a combination valve-in-block and overhead-valve construction and is three-point mounted on the frame. Engine assembly and mounted engine accessories are accessible when the hood is raised.

c. Transmission (fig. 42).—The conventional three-speed Warner gear transmission is mounted directly on the rear of the engine assembly. The transmission is provided with three forward speeds and one reverse speed, all manually selected by the driver by means of a transmission gearshift lever mounted on top of the transmission and extending into the driving compartment.

d. Transfer (fig. 42).—To supplement the power of the transmission, a two-speed Spicer transfer is mounted on the rear of the transmission. The transfer provides additional gear reduction for negotiating difficult terrain and also provides a power line to the front driving axle. The transfer is manually operated by the driver through a set of transfer shift levers located on top of the transfer and extending into the driving compartment.

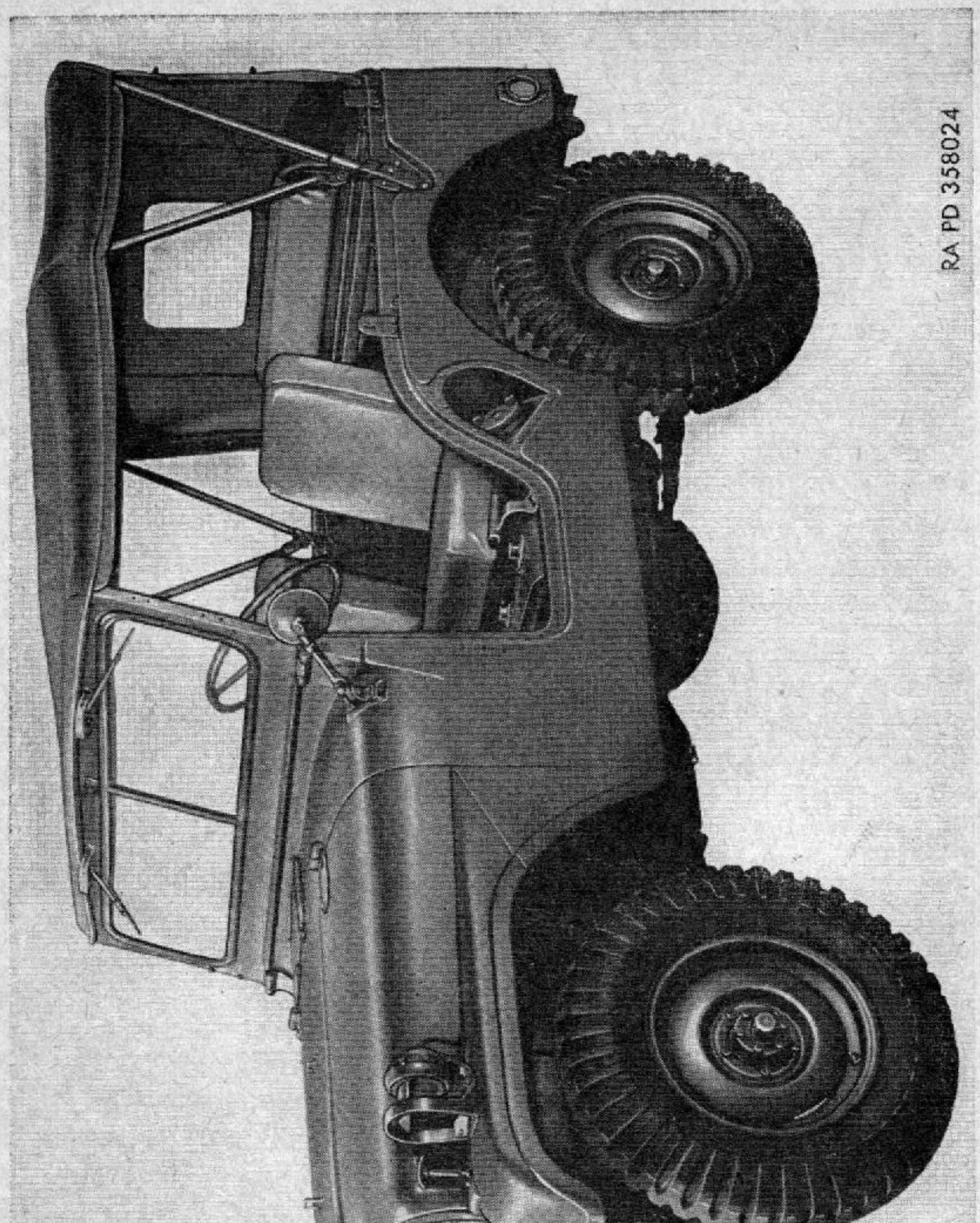


Figure 1. ¼-ton 4 x 4 utility truck M38A1—left front view.

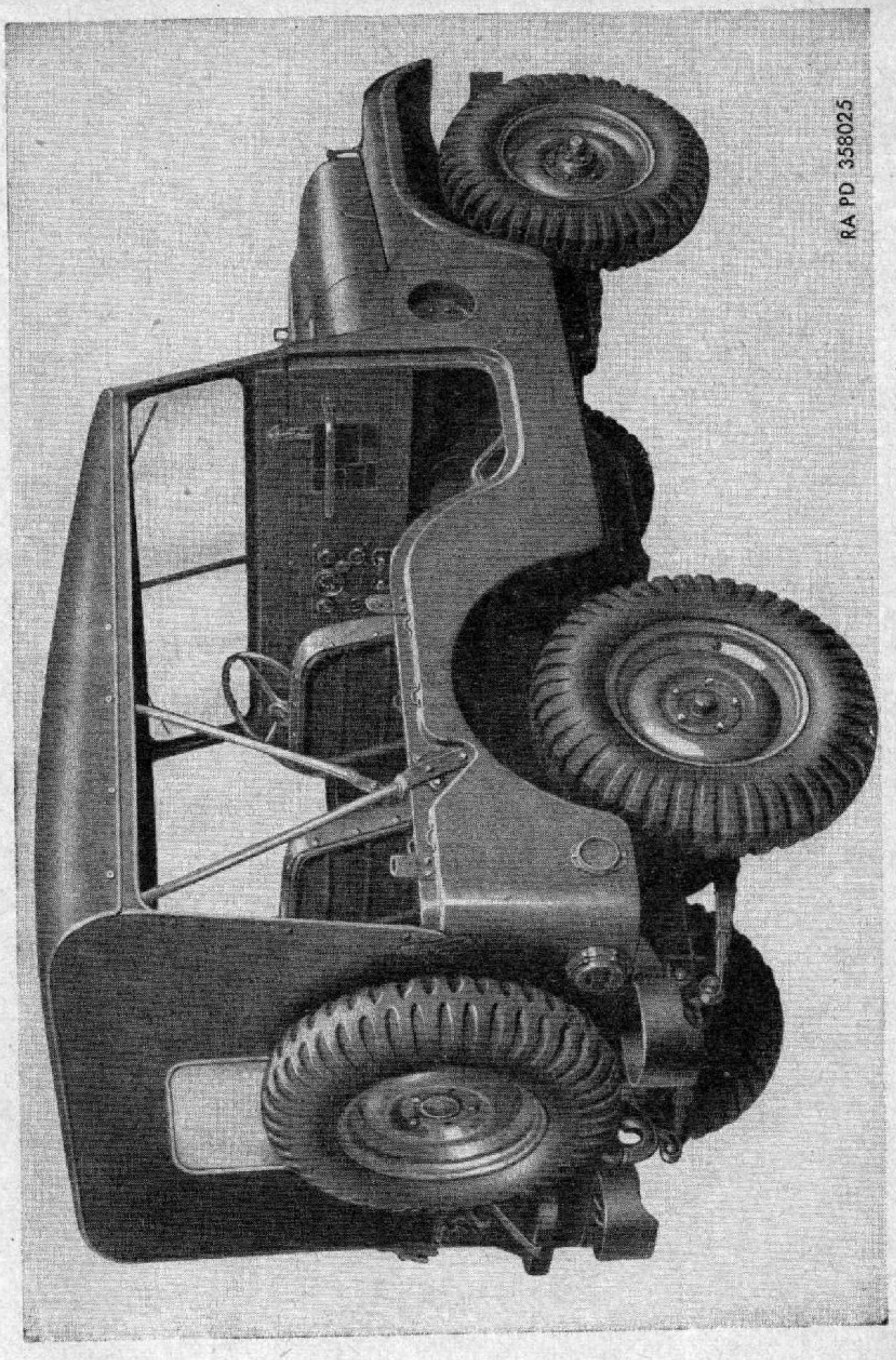


Figure 2. ¼-ton 4 x 4 utility truck M38A1—right rear view.

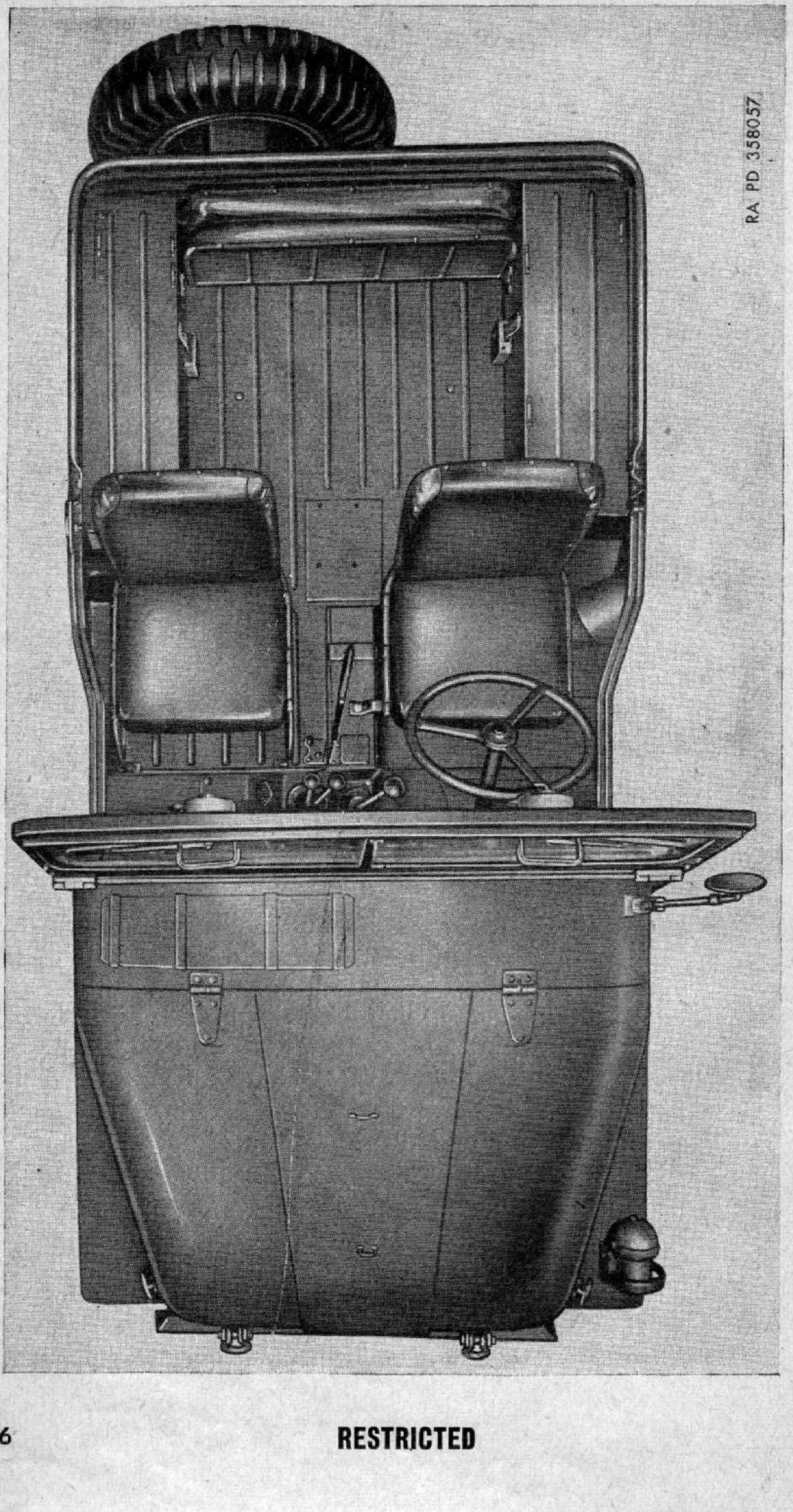


Figure 3. ¼-ton 4 x 4 utility truck M38A1—top view.

e. Front Axle and Suspension.

(1) The front driving axle is a full-floating, hypoid, single reduction type having a two pinion differential and hypoid drive gears. The axle assembly incorporates constant velocity universal joints at steering knuckles to permit steering in a conventional manner. Conventional type propeller shaft (fig. 98) connected to the transfer provides the drive line.

(2) Front axle suspension consists of two sets (one set on either side) of semielliptic, leaf type springs (fig. 117) shackled to the frame at the rear and bolted at the front and attached to the front axle assembly by **U** type spring clips.

f. Rear Axle and Suspension.

(1) The rear driving axle (fig. 107) is of the semifloating, hypoid, single reduction type. The rear axle is driven by a conventional type propeller shaft (fig. 99) connected to the transfer.

(2) The rear axle suspension consists of two sets (one set on either side) of semielliptic, leaf type springs (fig. 118) shackled to the frame at the rear and bolted at the front and attached to the rear axle assembly by **U** type spring clips.

g. Brake System (fig. 109).

(1) The service brakes are of the full-floating, hydraulic type with brakes on all four wheels. Service brakes are controlled by operation of the service brake pedal (fig. 7) in the driving compartment.

(2) The parking brake is a mechanical type brake incorporating a mechanism mounted on the rear of the transfer. The parking brake is actuated by a control rod connected to the hand control mechanism and the parking brake control handle (fig. 7) in the driving compartment.

5. Name, Caution, and Instruction Plates

a. Name and Data Plates.

(1) *Truck name and identification plate* (fig. 4). This identification plate is located on the instrument panel at the right of the instrument cluster. This identification plate includes vehicle name, serial number, manufacturer's name, part number, model number, contract number, and ordnance stock number.

(2) *Truck servicing data plate* (fig. 4). This data plate is located on the right of the instrument cluster. This data plate includes servicing information of the electrical system, fuel octane, tire inflation pressures, engine, transmission, gear oil, chassis grease, and cooling system.

(3) *Truck responsible agency plate* (fig. 4). This data plate is located on the instrument panel to the right of the instrument cluster. This data plate provides a list of the agencies responsible for maintenance of various parts of the vehicle.

(4) *Truck weight and dimension data plate* (fig. 4). This data plate is located on the instrument panel at the right of the instrument cluster. This data plate provides information of vehicle dimensions, weights, and maximum towed load.

(5) *Engine serial number* (fig. 5). The manufacturer's engine serial number is stamped on the engine cylinder block behind the water pump and below the thermostat housing at the front of the engine.

(6) *Transmission name, model, and serial number.* The transmission serial number (manufacturer's) (fig. 97) is stamped at the top left corner of the transmission case and the transmission name (fig. 96) and model number is stamped into the right rear side of the transmission case.

(7) *Transfer name, model, and serial number.* The transfer serial number (manufacturer's) (fig. 96) is stamped on top of the transfer housing and the transfer name (fig. 96) and model number are stamped on the right side of the transfer housing.

(8) *Distributor and ignition coil assembly name plate* (fig. 57). This name plate is located on the right side of distributor and ignition coil assembly and includes manufacturer's model number and voltage data.

(9) *Starter name plate* (fig. 66). This name plate is located on the right side of the starter and includes voltage, direction of rotation, ordnance part number, manufacturer's model number, and serial number.

(10) *Generator name plate* (fig. 68). This name plate is located on the right side of the generator and includes ordnance part number, manufacturer's model number, voltage, amperage, and serial number.

(11) *Generator regulator name plate* (fig. 69). This name plate is located on the right side of the generator regulator base and the name is stamped into the generator regulator cover. The name plate includes voltage rating, serial number, model number, ordnance number, and capacity.

(12) *Carburetor name* (fig. 48). The carburetor name and model number is stamped on the side of the carburetor float bowl.

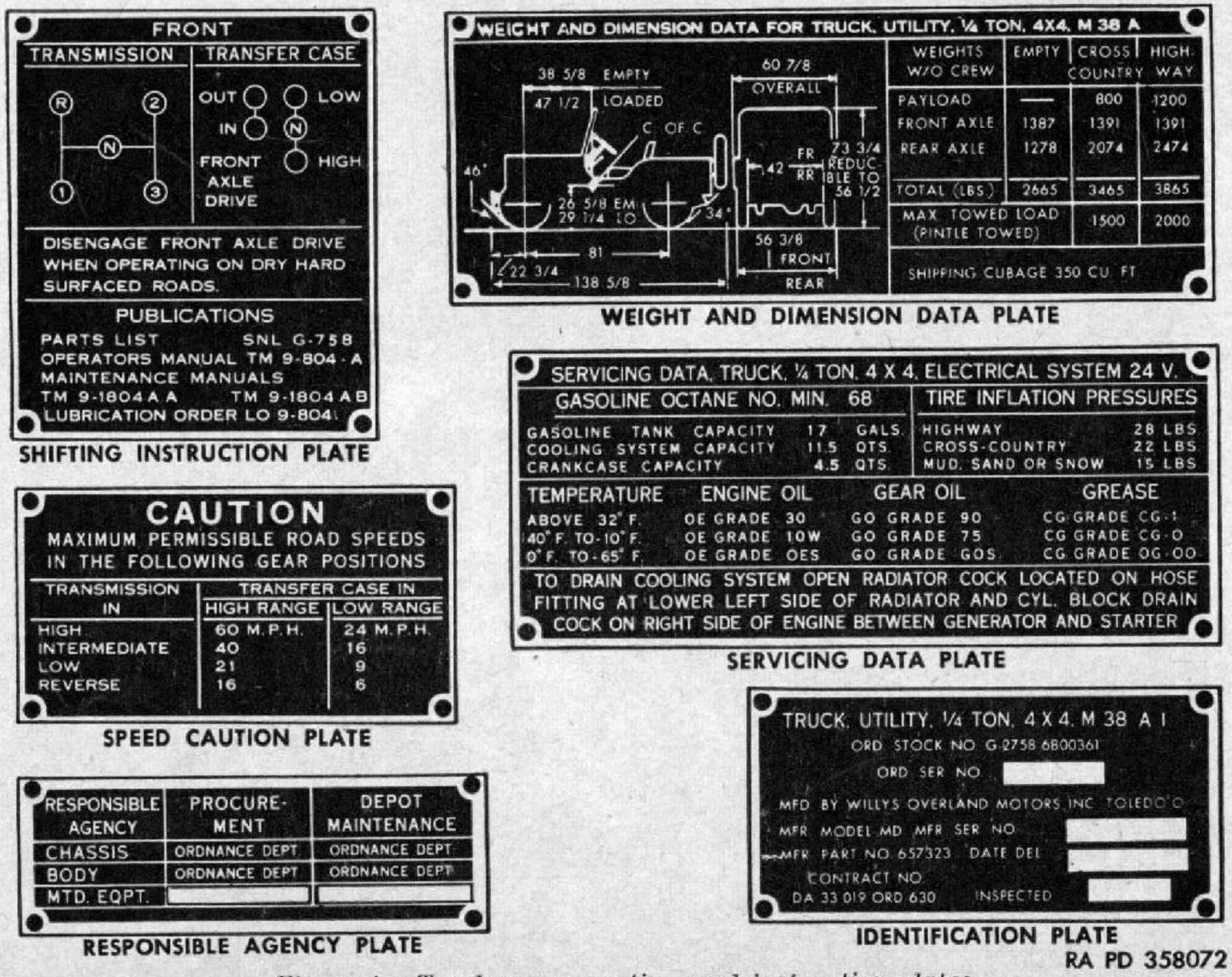


Figure 4. Truck name, caution, and instruction plates.

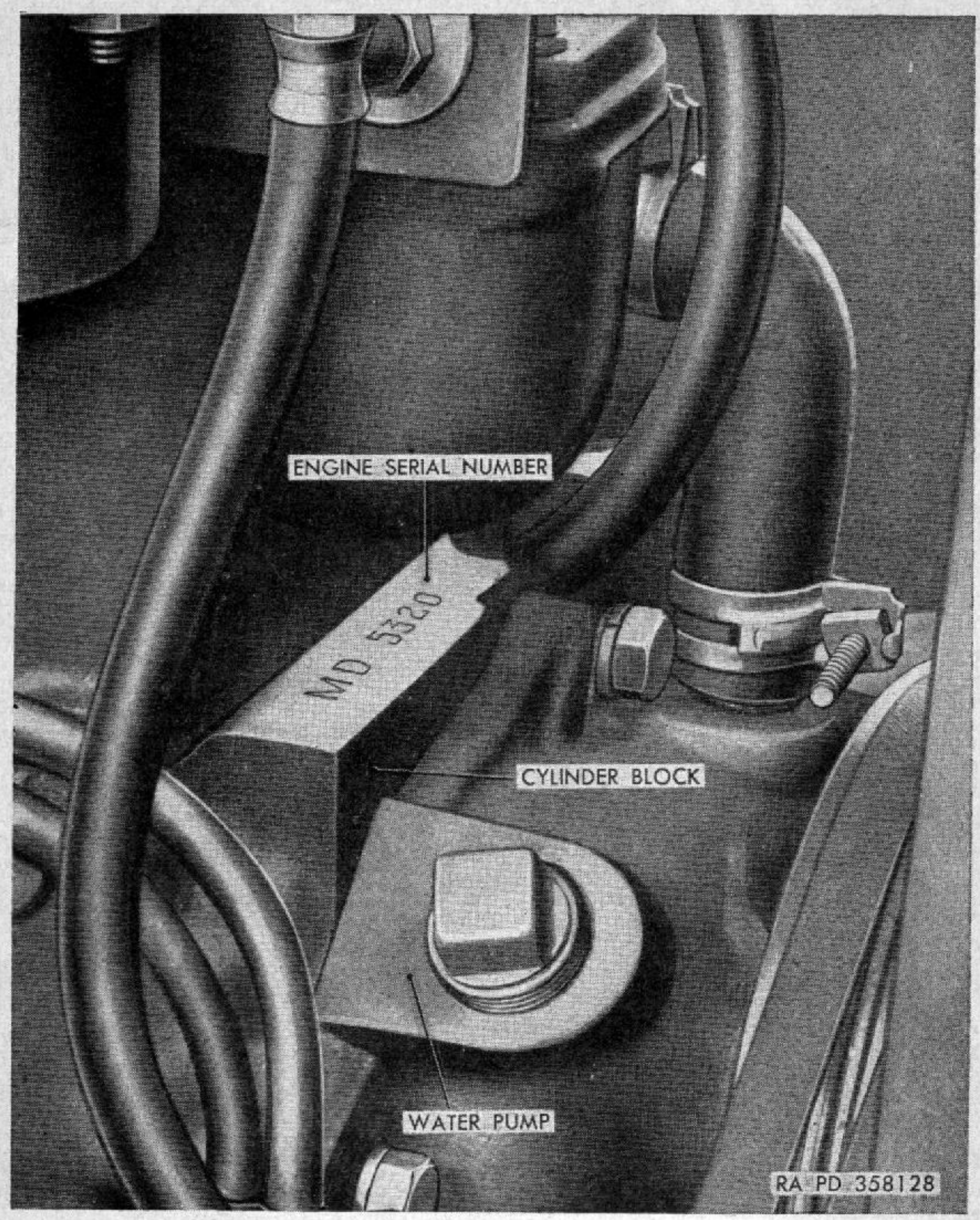


Figure 5. Engine serial number location.

(13) *Truck name, patent, and serial number plate.* This name plate is attached to the front of the right rear wheel housing and provides information of vehicle name, patent number, and serial number.

b Caution Plates.

(1) *Truck speed caution plate* (fig. 4). The caution plate is located on the instrument panel at the right of the instrument cluster. This plate provides information of permissible road speeds for various gear positions.

(2) *Generator regulator warning* (fig. 69). A warning is stamped on the front edge of the generator regulator cover. This is a warning to disconnect the battery ground cable before attempting to remove generator or generator regulator.

c. Instruction Plates and Decalcomania.

(1) *Truck shifting instruction plate* (fig 4). This instruction plate is located on the instrument panel at the right of the instrument cluster. This instruction plate provides a shifting diagram for the transmission and transfer and shows how to engage and disengage the front driving axle. Also provided on this instruction plate is a list of the applicable publications issued for the vehicle.

(2) *Crankcase ventilator valves control instruction plate* (fig. 8). This instruction plate is attached to the instrument panel behind the crankcase ventilator valves control (fig. 7) and shows the correct positions of the crankcase ventilator control valves when fording.

(3) *Generator cable disconnect decalcomania.* This decolcomania, providing instructions for disconnecting battery cables when working on generator or generator regulator, is located on the splash pan.

6. Tabulated Data

a. General Data.

Vehicle weight w/o crew:	
Highway	3,865 lb
Cross country	3,465 lb
Pay load (max):	
Highway	1,200 lb
Cross country	800 lb
Towed load (max):	
Highway	2,000 lb
Cross country	1,500 lb
Crew (operating)	1
Passengers (including crew)	4
Engine (type)	4 cylinder, gasoline, F-head
Electrical system	24 volt
Number of batteries	2
Tires—type	nondirectional mud and snow-6-ply

b. Dimensional Data.

Wheelbase	81 in
Length, overall (max)	138⅝ in
Width, overall (max)	60⅞ in
Height, overall (max)	74¾ in
Height, lowest operable (over steering wheel)	56½ in

b. Dimensional Data—Continued

Tread—front	49⅛ in
Tread—rear	49 3/16 in
Tire size	7.00 x 16
Tire pressure	28 psi
Ground clearance (min)	9 5/16 in
Pintle hook height (center of hook)	21½ in

c. Performance.

Angle of approach	46 deg
Angle of departure	34 deg
Minimum turning radius:	
Right	19 ft 4 in
Left	19 ft
Minimum turning diameter:	
Right	40 ft 6 in
Left	49 ft 6 in
Maximum fording depth:	
Without fording equipment	37½ in
With fording equipment	75½ in
Maximum grade ascending ability	69 percent
Cruising speed	55 mph
Engine horsepower at 4,000 rpm	70
Maximum recommended speeds with transfer in HIGH range:	
High	60 mph
Intermediate	40 mph
Low	21 mph
Reverse	16 mph
Maximum recommended speeds with transfer in LOW range:	
High	24 mph
Intermediate	16 mph
Low	9 mph
Reverse	6 mph

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATÉRIEL

7. Purpose

a. When a new or reconditioned vehicle is first received by the using organization, it is necessary for the organizational mechanics to determine whether the vehicle has been properly prepared for service by the supplying organization and is in condition to perform any mission to which it may be assigned when placed in service. For this purpose, inspect all assemblies, subassemblies, and accessories to be sure they are properly assembled, secure, clean, and correctly adjusted and/or lubricated. Check all tools and equipment (pars. 49 through 52) to be sure every item is present, in good condition, clean, and properly mounted or stowed.

b. In addition, perform a "break-in" of at least 50 miles on all new or reconditioned vehicles and a sufficient number of miles on used vehicles to completely check their operation, according to procedures in paragraph 9.

c. Whenever practicable, the vehicle driver will assist in the performance of these services.

8. Preliminary Service

a. General Inspection and Servicing Procedures.

(1) Uncrate vehicle, if crated. Remove metal strapping, plywood, tape, wrapping paper, and dehydrant bags. If any exterior surfaces are coated with rust-preventive compound, remove it with dry-cleaning solvent or volatile mineral spirits.

(2) Read Processing Record for Storage or Shipment tag and follow all precautions checked thereon. This tag should be on the driver's compartment attached to the steering wheel or ignition switch.

(3) Crank engine by hand at least two complete revolutions, before turning ignition switch on, to test for hydrostatic lock. (This precaution is taken because there may be an excess of

preservative oil in the combustion chambers or, possibly, coolant may have leaked into them.)

Note.—If the vehicle has been driven to the using organization, (1) and (2) above must be performed.

(4) Make a general inspection to see if items are in good condition, correctly assembled or stowed, secure, not excessively worn, not leaking, and adequately lubricated. These instructions apply to most items in the preventive maintenance and inspection procedures (table II). Any, or all, of these checks that are pertinent to any item (including supporting, attaching, or connecting members) will be performed automatically, as general procedures, in addition to any specific procedures given.

b. Specific Procedures. For preliminary service perform the commander's C (6,000 miles or 6 months) preventive maintenance service, with the following variations:

(1) Line out the other services on the form (DA Form 461) and write in "New (or Rebuilt) Vehicle Reception."

(2) Before staring engine, tighten cylinder-head nuts with a torque-indicating wrench, to 65 to 75 pound-feet torque in the sequence figure 28 prescribed.

(3) Item 27. Perform this item before starting the road test. If a processing tag on the engine or vehicle states that the engine contains preservative oil that is suitable for 500 miles of operation and of the correct seasonal viscosity, check the level but do not change the oil; otherwise change oil. Lubricate all points, regardless of interval, except as noted in (6) below. Check the level of the lubricant in the transmission, front axle, and rear axle. If the gear lubricant is known to be of the correct seasonal grade, do not change it; otherwise change it.

(4) After the engine has been thoroughly warmed up to operating temperature, check the tightness of the cylinder-head nuts with a torque-indicating wrench. Tighten to 65 to 75 pound-feet torque in the proper sequence (fig. 28).

(5) Item 35. Inspect breaker points; dress, if necessary.

(6) Item 39. Look at wheel bearings. If lubrication appears to be adequate, do not clean and repack. Do not adjust brakes unless necessary.

9. Break-In

Refer to paragraphs 39 through 43 for operating instructions. After the preliminary service has been performed (par. 8), the break-in period (500 miles) may be accomplished in normal service of the vehicle under the supervision of a competent driver. The driver will be cautioned against excessive speeds, skipping speeds in shifting gears, rapid acceleration, or in any way loading the engine or power train to capacity during the break-in period. If the vehicle was driven to the using organization, include the mileage traveled in the break-in mileage.

10. Correction of Deficiencies

a. Ordinary deficiencies disclosed during the preliminary inspection and servicing or during the break-in period will be corrected by the using organization or a higher maintenance echelon.

b. Serious deficiencies, which appear to involve unsatisfactory design or material, will be reported on DA Form 468. The commander of the using organization will submit the completed form to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM, or chief of appropriate technical service for other than ordnance material.

Section II. CONTROLS AND INSTRUMENTS

11. General

a. This section describes, locates, illustrates, and furnishes the driver with sufficient information of the various controls and instruments provided for proper operation of the vehicle.

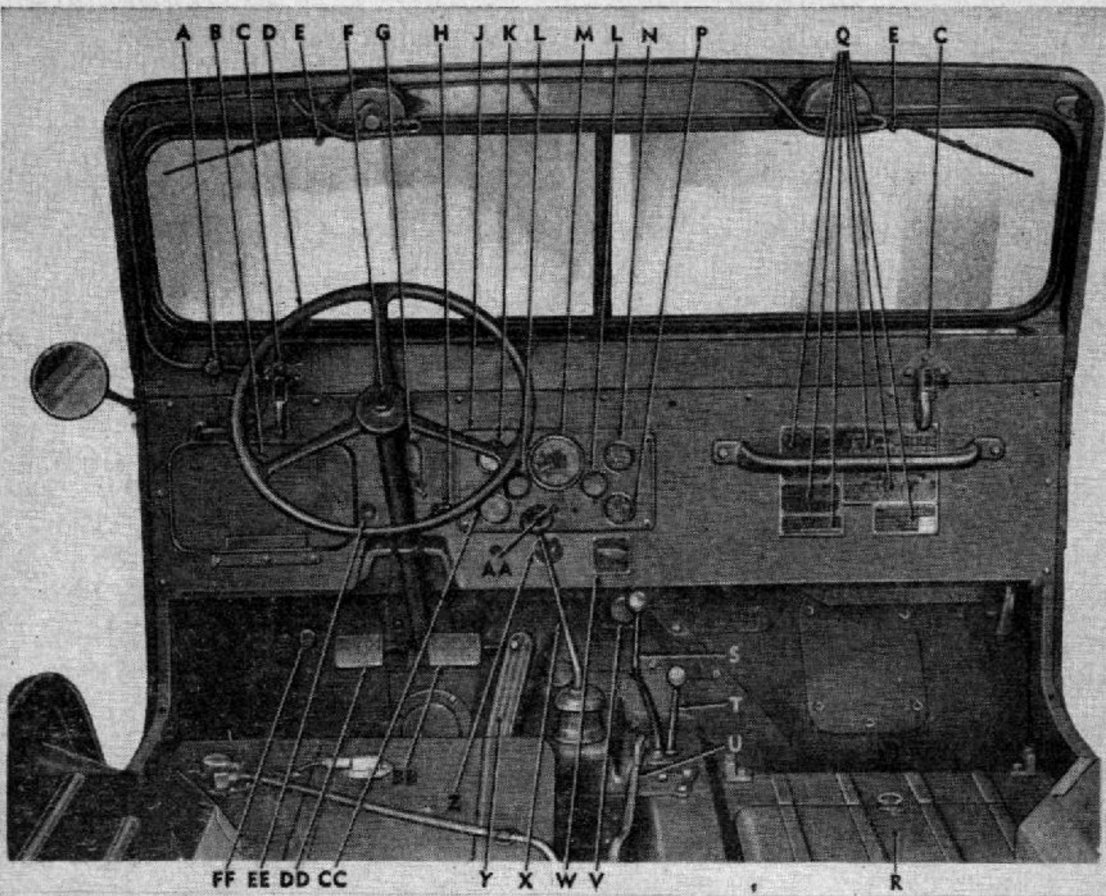
b. All pedal and hand lever controls, instruments, gages, and switches are grouped in the driver's compartment (figs. 6 and 7) and are readily accessible to the driver for the operation of the vehicle. The major graduations, letters, figures, and pointer tips on all instruments and gages grouped in the instrument cluster (fig. 6) are coated with luminous paint for visibility during night operation.

12. Steering Wheel

The steering wheel (figs. 6 and 7) is located on the left side of the driving compartment. The purpose of this wheel is to turn the front wheels for the purpose of steering the vehicle. Degree of turn of the steering wheel is in proportion to turn of front wheels. The steering wheel should be turned clockwise when a right turn is desired and counterclockwise when a left turn is desired.

13. Service Brake Pedal

The service brake pedal (figs. 6 and 7) is located on the toe board to the right of the steering gear column and is accessible to the driver's



A—WINDSHIELD WIPER SHUT-OFF VALVE
B—MAP COMPARTMENT LOCK
C—WINDSHIELD CLAMPS
D—STEERING WHEEL
E—WINDSHIELD WIPER HANDLE
F—HORN BUTTON
G—LIGHT SWITCH
H—THROTTLE CONTROL
J—INSTRUMENT CLUSTER
K—AMMETER
L—INSTRUMENT PANEL LIGHTS
M—SPEEDOMETER
N—FUEL GAGE
P—ENGINE OIL PRESSURE GAGE
Q—NAME, INSTRUCTION, AND CAUTION PLATES
R—TOOL COMPARTMENT
S—TRANSFER DIRECT AND UNDERDRIVE GEARSHIFT LEVER
T—TRANSFER FRONT WHEEL DRIVE GEARSHIFT LEVER
U—PARKING BRAKE CONTROL HANDLE
V—STARTER SWITCH PEDAL
W—CRANKCASE VENTILATOR VALVES CONTROL
X—TRANSMISSION GEARSHIFT LEVER
Y—ACCELERATOR PEDAL
Z—IGNITION SWITCH
AA—HEAD LIGHT BEAM INDICATOR LIGHT
BB—SERVICE BRAKE PEDAL
CC—ENGINE TEMPERATURE GAGE
DD—CLUTCH PEDAL
EE—CHOKE CONTROL
FF—DIMMER SWITCH

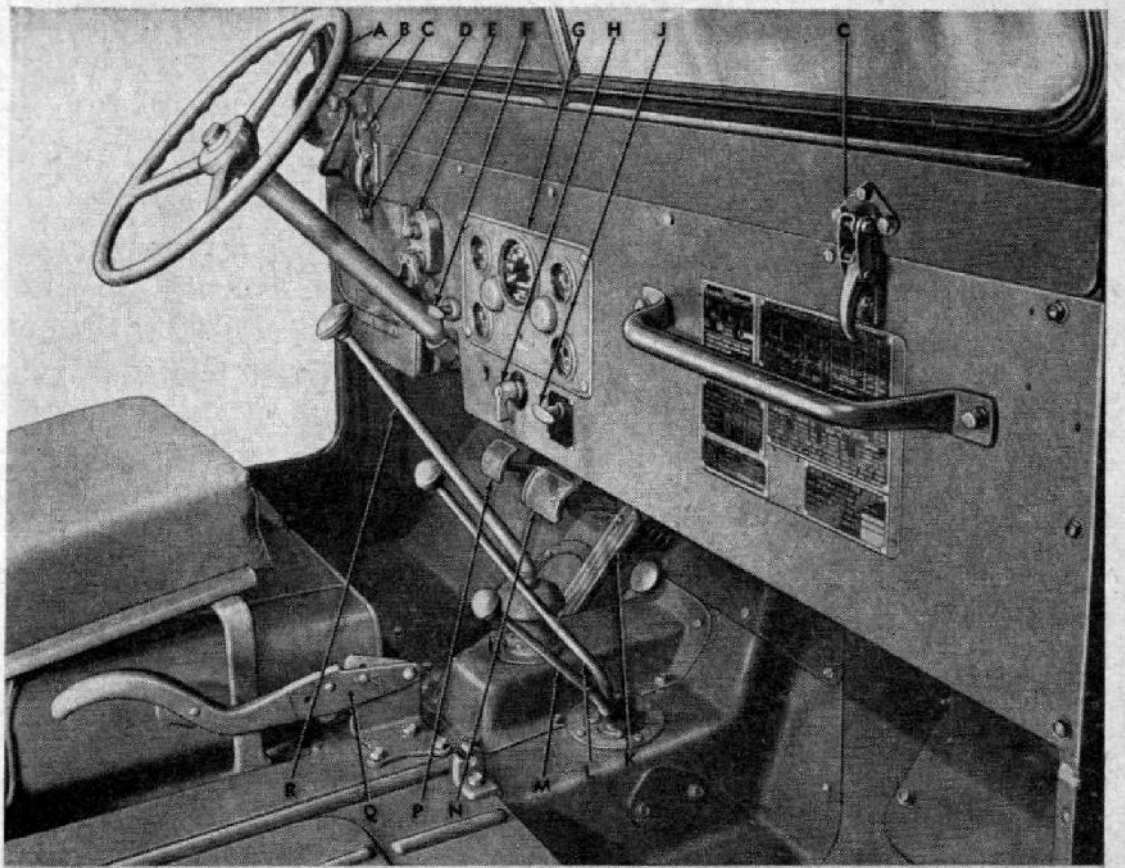
RA PD 358129

Figure 6. Driver's compartment—rear view.

right foot. The service brake pedal controls the hydraulic service brakes on all four wheels and is applied by depressing the pedal. The degree of brake application is dependent upon the amount of physical effort applied to the brake pedal. The brake pedal will return to the normal or released position when foot pressure is released.

14. Clutch Pedal

The clutch pedal (figs. 6 and 7) is located on the toe board at the left of the steering column and is accessible to the driver's left foot.



A—STEERING WHEEL
B—WINDSHIELD WIPER SHUT-OFF VALVE
C—WINDSHIELD CLAMP
D—MAP COMPARTMENT LOCK
E—LIGHT SWITCH
F—THROTTLE CONTROL
G—INSTRUMENT CLUSTER
H—IGNITION SWITCH
J—CRANKCASE VENTILATOR VALVES CONTROL
K—ACCELERATOR PEDAL
L—TRANSFER DIRECT AND UNDERDRIVE GEARSHIFT LEVER
M—TRANSFER FRONT WHEEL DRIVE GEARSHAFT LEVER
N—SERVICE BRAKE PEDAL
P—CLUTCH PEDAL
Q—PARKING BRAKE CONTROL HANDLE
R—TRANSMISSION GEARSHIFT LEVER

RA PD 358130

Figure 7. Driver's compartment—right view.

The clutch pedal is provided to engage and disengage the engine from the transmission. When the clutch pedal is depressed, the engine power is disconnected from the transmission; when clutch pedal is released, the engine is connected to the transmission. Clutch pedal will automatically release when foot pressure is released.

15. Accelerator Pedal

The accelerator pedal (figs. 6 and 7) is located on the toe board to the right of the brake pedal. The accelerator pedal controls the speed of the engine from idling to full speed, in varying degrees dependent upon the foot pressure applied. Designed for operation by the driver's right foot, the accelerator pedal will automatically return the engine to idling speed when foot pressure is released.

16. Starter Switch Pedal

The starter switch pedal (fig. 6) is attached to the toe board and is located at the right of the accelerator pedal. This pedal, when depressed, actuates the starter switch on the starter to engage the starter with the engine flywheel, thus turning the engine. Starter switch pedal automatically returns to normal position when released.

17. Transmission Gearshift Lever

The transmission gearshift lever (figs. 6 and 7) is located in the transmission control lever housing on top of the transmission and extends upward into the passenger compartment. This shift lever provides manual control and selection of desired gears and speeds in the transmission. Gearshift lever may be moved to either of five various positions including neutral, indicated on the shifting instruction plate (fig. 4). Operation of the transmission gearshift lever will be found in paragraph 41.

18. Transfer Direct and Underdrive Gearshift Lever

The transfer direct and underdrive gearshift lever (figs. 6 and 7) is located on the transfer output shaft front bearing cap and extends upward into the passenger compartment to the right of the transmission gear shift lever. This gearshift lever provides for manual selection of auxiliary speed ranges in the transfer. The gearshift lever may be positioned in any one of three positions depending upon operating conditions. The shifting instruction plate (fig. 4) indicates positions of gearshift lever and paragraph 41 explains operation.

19. Transfer Front Wheel Drive Gearshift Lever

The transfer front wheel drive gearshift lever (figs. 6 and 7) is located on the transfer output shift front bearing cap and extends upward into the passenger compartment at the left of the transfer direct and underdrive gearshift lever. This gearshift lever controls the front driving axle drive selection. Shifting positions for this gearshift lever are indicated on the shifting instruction plate (fig. 4). Operation of the transfer front wheel drive gearshift lever is covered in paragraph 41.

20. Parking Brake Control Handle

The parking brake control handle (figs. 6 and 7) is located between the driver's and passenger's seats attached to the floor. This control handle actuates a mechanical parking brake on the rear of the transfer. To set parking brake, pull upward on parking brake control handle; to release it, press trigger on the handle and allow handle to return to the released position. A ratchet mechanism on the handle will hold the parking brake applied until released by pressing trigger.

21. Throttle Control

The throttle control (figs. 6 and 7) is located at the lower edge of the instrument panel at the right of the steering wheel and provides a hand operated control of engine speeds. It is primarily used to set the carburetor throttle at the desired starting and warm-up speed. To accelerate engine, pull throttle control out to desired position.

22. Choke Control

The choke control (fig. 6) is located at the lower edge of the instrument panel at the left of the steering wheel. This control is connected to the carburetor choke valve plate which closes in proportion to the degree the choke control is pulled out. The choke control is used when starting and operating a cold engine. Choke control must be pushed all the way in after engine is started and operating correctly.

23. Dimmer Switch

The foot-operated dimmer switch (fig. 6) is located on the floor at the left of the clutch pedal, accessible to the driver's left foot. The dimmer switch controls the upper and lower beams of the service headlights. Use of this dimmer switch permits the driver to dim headlights when passing other vehicles and then return them to bright when needed. Dimmer switch is operated only when light switch is positioned (par. 41*i* (2)) on "SER DRIVE" (fig. 9).

24. Horn Button

The horn button (fig. 6) is located in the center of the steering wheel and is depressed to sound electric horn.

25. Windshield Wiper Shut-Off Valve

The windshield wiper shut-off valve (figs. 6 and 7) is located on the vacuum line to the left of the steering wheel above the instrument panel. This shut-off valve controls the engine vacuum required to operate both windshield wiper motors. To operate windshield wipers, turn shut-off valve counterclockwise. Turn shut-off valve clockwise to shut windshield wipers off. A windshield wiper handle (fig. 6) is mounted on each windshield motor for manual operation of the blade. Move handle back and forth to operate windshield wiper blade.

26. Ignition Switch

A lever type ignition switch (figs. 6 and 7) is mounted on the instrument panel, directly below the instrument cluster. The ignition switch lever must be turned to the left to complete the ignition circuit before the engine can be started. When the ignition circuit is completed, all electrical gages in the instrument cluster (fig. 6) will become energized, permitting readings of their values. Operation of ignition switch in conjunction with starting the engine and stopping the engine is contained in paragraphs 40 and 41.

27. Light Switch

The light switch (figs. 6 and 7) is located on the instrument panel directly above the steering column. Three levers are provided on the light switch to control the various lighting circuits. The light switch controls all the lights provided on the vehicle. Operation of light switch is explainted in paragraph 41*i*. Purpose of the various levers is explained below:

a. Main Switch Lever. The five position main switch lever is located at the upper portion of the light switch with switch lever pointing up (fig. 9). This main switch lever can be positioned to control all vehicle lights except panel lights and parking lights. The mechanical switch (or locking) lever must be used when positioning main switch lever to any position.

b. Auxiliary Switch Lever. The auxiliary switch lever (fig. 9) is located at the left and below main switch lever. The auxiliary switch lever may be positioned to control parking and instrument panel lights when the main switch lever is in position as explained in paragraph 41.

c. Mechanical Switch Lever. The mechanical switch (or locking) lever is located at the right and below the main switch lever (fig. 9). This mechanical switch lever holds the main switch lever in the OFF position to prevent inadvertent turning on of lights. This lever must be held in the raised position before main switch lever can be moved to any position.

28. Speedometer

The speedometer (fig. 6) is located on the instrument panel in the center of the instrument cluster and registers the vehicle's speed in miles per hour. The odometer in the center of the speedometer, registers the accumulated miles the vehicle has been driven.

29. Ammeter

The ammeter (fig. 6) is located in the upper left corner of the instrument cluster. This ammeter is in effect an indicator showing the activity and condition of the generator charging circuit. A slight "charge" should be indicated under normal operating conditions. For a short time immediately after starting the engine, a slightly higher "charge" will be indicated on the ammeter until the current used to start the engine is replaced in the battery by the generator.

30. Fuel Gage

The fuel gage (fig. 6) is located in the upper right corner of the instrument cluster. The fuel gage indicates the level of fuel in the fuel tank. Fuel gage dial face is graduated in quarters from E (empty) to F (full).

Note.—Ignition switch must be turned on to show reading on fuel gage.

31. Engine Oil Pressure Gage

The engine oil pressure gage (fig. 6) is located in the lower right corner of the instrument cluster. The dial face of the engine oil pressure gage is marked from 0 to 120 psi in graduations of 30 psi. This gage indicates the pressure of the engine oil when the engine is running.

Note.—Engine oil pressure does not indicate amount of oil in engine crankcase.

Under normal operating conditions the engine oil pressure gage should indicate 30 to 35 psi and when idling approximately 10 psi. Absence of oil pressure when engine is running indicates faulty oiling system or inoperative gage circuit; engine should be immediately stopped.

Note.—When engine is started cold, oil pressure may indicate slightly high but, under normal conditions, will return to normal reading (30 to 35 psi) after engine has warmed up.

32. Engine Temperature Gage

The engine temperature gage (fig. 6) is located in the lower left corner of the instrument cluster. The dial face of the engine temperature gage is marked from 60° to 260° F. in graduations of 40° F. This gage indicates the temperature of the engine coolant and is actuated by a sending unit mounted on the engine. Normal operating temperature is 160° to 180° F. If temperature gage indicates excessively high or low readings, it indicates either a faulty cooling system or defective gage circuit. Stop engine immediately and investigate cause.

33. Instrument Panel Lights

The two instrument panel lights (fig. 6) are located on the instrument cluster below, and one to either side of the speedometer. The purpose of the instrument panel lights are to provide illumination for the instruments and gages during night operation. Instrument panel lights (fig. 9) are actuated by the auxiliary switch lever on the light switch (par. 41). Three positions on the light switch permits instrument panel lights to be turned either off, on dim, or on bright. Metal shields over the panel light lamp prevents reflection during night operation.

34. Headlight Beam Indicator Light

The headlight beam indicator light (fig. 6) is located in the instrument cluster below the speedometer. The purpose of this indicator light is to indicate when the high beam of the headlights are on. Indicator light will go out when headlights are returned to low beam by operating the dimmer switch.

35. Windshield Clamps

Two windshield clamps (figs. 6 and 7) are provided on the windshield assembly to hold the windshield assembly in the vertical position. The windshield clamp engages with a catch on the instrument panel. To lower windshield, pull clamp out at the bottom to disengage it from catch.

36. Map Compartment Lock

The map compartment lock (figs. 6 and 7) is located on the map compartment door to the extreme left of the instrument panel. The map compartment lock permits latching of the map compartment door providing access to the map compartment. To open map comparment door, press button in center of lock and pull door open. Map compartment lock will automatically latch when the door is closed.

37. Tool Compartment

The tool compartment is located under the front passenger seat on the right side of driver's compartment and provides for stowage of vehicular tools. To gain access to tool compartment, swing front passenger seat up and forward. Grasp tool compartment lid handle and pull upward.

38. Crankcase Ventilator Valves Control

The crankcase ventilator valves control (figs. 6 and 7) is located on the instrument panel below the instrument cluster. This control is provided for the driver to seal the crankcase for under-water operation, when the fording kit is installed, without lifting the hood. To operate crankcase ventilator valves, follow instructions on the crankcase ventilator valves control instruction plate (fig. 8) attached to the instrument panel.

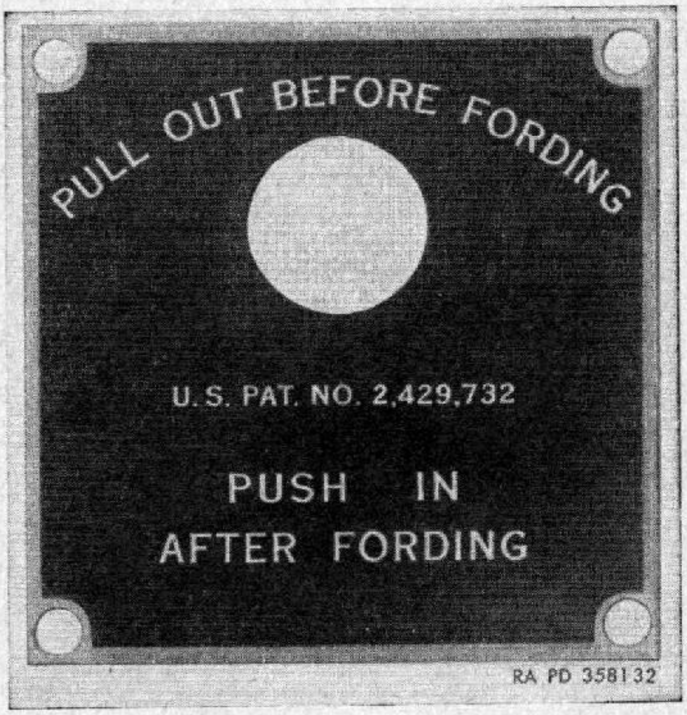


Figure 8. Crankcase ventilator valves control instruction plate.

Section III. OPERATION UNDER USUAL CONDITIONS

39. General

This section contains instructions for the mechanical steps necessary to operate the ¼-ton 4 x 4 utility truck M38A1 under conditions of moderate temperature and humidity. For operation under unusual conditions, refer to paragraphs 44 through 48.

40. Starting the Engine

a. Before starting and warming up the engine, the driver should familiarize himself with the controls and instruments listed in paragraph 11 through 38.

Caution.—Perform the before-starting preventive maintenance services listed in table II before starting and warming up the engine.

b. Position the transmission gearshift lever (figs. 6 and 7) in the neutral position indicated on the shifting instruction plate (fig. 4).

c. Pull the throttle control (figs. 6 and 7) out approximately three-quarters to one inch.

d. Pull the choke control (fig. 6) all the way out.

Note.—If engine has been recently operated and is still warm, choking will not be necessary. A priming pump is to aid starting in extreme cold weather (par. 45).

e. Turn ignition switch (fig. 6) clockwise to ON position.

f. Depress clutch pedal (figs. 6 and 7) to disengage clutch from engine while engine is being started.

g. Depress starter switch pedal (fig. 6) until starter operates to crank engine; release starter switch pedal the moment engine is started.

Caution.—Do not hold starter engaged for periods in excess of 30 seconds to avoid overheating and resultant damage to starter. If starter has been engaged without results, wait for 15 seconds; then crank engine again. If, after several attempts, the engine fails to start, determine the cause (par. 65).

h. After engine starts, adjust choke control and throttle control (fig. 6) to even idling speed.

i. Check the reading on the engine oil pressure gage and ammeter (fig. 6). Engine oil pressure gage should indicate approximately 10 p. s. i. at idling with engine warm and higher if engine is cold. Ammeter reading should be slightly to the charge side or slightly higher directly after engine has been started.

j. Check the readings on the engine temperature gage and fuel gage (fig. 6). After the engine has warmed up for several minutes, note indications on engine temperature gage. If engine heats up excessively (above 180° F.) during warm-up, investigate cause (par. 65). Check fuel gage to see if there is sufficient fuel to perform mission vehicle has been assigned to.

41. Driving the Vehicle

Note.—Before a new or reconditioned vehicle is placed into service, perform the break-in as outlined in paragraph 9.

a. Placing the Vehicle in Motion.

(1) Place transfer direct and underdrive gearshift lever (fig. 6), in the rear position to engage transfer HIGH range. If the front driving axle is to be used for four wheel driving, place transfer front wheel drive gearshift lever (fig. 6) in the rear of "IN" position. If the front driving axle is to be dis-

engaged, move transfer front wheel drive gearshift lever to the forward or OUT position.

Note.—Transfer shifting diagrams are located on the shifting instruction plate (fig. 4) on the instrument panel to aid in gear shift lever selection.

(2) Depress clutch pedal (fig. 6) and move the transmission gearshift lever (fig. 6) over toward the driver's side and down to engage low (1st) gear.

Note.—Transmission gearshift lever positions are diagramed on the shifting instruction plate (fig. 4) on the instrument panel.

(3) Release parking brake control handle (fig. 6) by pressing trigger on handle and lowering to released position.

(4) Depress accelerator pedal (fig. 6) slightly to increase engine speed, and at the same time, slowly release the clutch pedal (fig. 6). As the clutch engages and the vehicle begins to move, gradually increase engine speed by increasing pressure on accelerator pedal.

Note.—During the next two operations perform the procedures outlined in table III under "during operations."

(5) Increase speed to approximately 10 mph, depress clutch pedal and at the same time, release all foot pressure on the accelerator pedal. While clutch pedal is depressed, move transmission gearshift lever up out of low gear, across neutral to the right, and up into second gear. No double clutching is required in this operation. Release clutch pedal and accelerate engine.

(6) When vehicle has attained a speed of approximately 20 mph, in second gear, depress clutch pedal and release accelerator pedal, and move transmission gearshift lever (fig. 6) down to high gear position. Release clutch pedal and accelerate engine.

b. Normal Driving.

(1) The greater part of the normal driving will be on paved or improved terrain where it is not necessary to use the front driving axle. Transmission gearshift lever should be left in third or high gear unless speed of vehicle reduces to a point where the engine begins to labor. In this case the vehicle should be placed in a lower gear range until speed again reaches a point where it may be safely shifted into third gear.

(2) Pressure on the accelerator pedal determines the speed of the engine and vehicle. To slow a vehicle down when there is no necessity for brakes, release the pressure on the accel-

erator pedal. It is not necessary to shift transmission when accelerating from speeds above 28 mph.

(3) To compensate for hills, the accelerator pedal must be depressed. When descending normal hills, release pressure on accelerator pedal.

Caution.—Never depress clutch pedal or disengage transmission when descending hills.

(4) When driving on wet or slippery paved roads, gage speed of vehicle accordingly to have maximum control at all times. Avoid turning steering wheel too sharply or negotiating hills or trenches in excess of the limits specified in the tabulated data (par. 6). Do not exceed speeds indicated on the speed caution plate (par. 5).

c. Shifting to Lower Gear Speed While in Motion (Double Clutching).

(1) When approaching unusually steep grades on rough terrain, it sometimes becomes necessary to shift the transmission to a lower gear range in order to retain complete control of the vehicle and keep the vehicle moving.

(2) When approaching a hill or a stretch of soft terrain, shifting gears to lower speeds may be accomplished without severe clashing or grinding by a "double clutching" method. The shift to a lower gear should be made before the engine starts to labor and the vehicle loses momentum.

(3) The following operations must be accomplished in sequence and as rapidly as possible to avoid unnecessary loss of vehicle speed.

(4) Depress clutch pedal and quickly move transmission gearshift lever to neutral.

(5) Release clutch pedal and accelerate engine to a speed approximating or slightly more than the speed needed to maintain the same vehicle speed in the lower gear being selected. This action speeds up the transmission drive gear to match the speed of the transmission driven gear, eliminating gear clash.

(6) Quickly depress pedal; move transmission gearshift lever from the neutral position to the desired (next lower) gear position; release clutch pedal and depress accelerator pedal to accelerate engine for desired vehicle speed.

Note.—The engine need not be accelerated for the two latter operations. When the two mating transmission gears engage at identical speeds, amount of clutch slippage will be negligible.

d. Shifting Gears in Transfer. The transfer gearshift levers (figs. 6 and 7) provide a means by which power may be applied to the front driving axle as well as the rear. In addition, the low range gear provided by the transfer doubles the number of speed ranges provided by the transmission. The selection of the various gear ratios depends upon the load and road conditions. Shift gears in the transfer with the instructions on the shifting instruction plate (par. 5) on the instrument panel, and observe the warnings on the speed caution plate, also on the instrument panel. Transmission gear selection does not, in any way, affect the selection or shifting procedure of the transfer. The vehicle may be driven by the rear axle alone or by both the front and rear axles. The front driving axle cannot be driven independently except in extreme emergencies when the rear propeller shaft is removed.

(1) *Engaging front driving axle.*

(a) The front driving axle should be engaged only in off-the-road operation, slippery road, steep grades, or during hard pulling and deep-water fording operations (par. 48). In ordinary use on average roads and under normal conditions, the front driving axle should be disengaged. Engagement of the front driving axle can be made with the vehicle stopped or in motion. Vehicle must be in front axle drive for use of LOW range of transfer.

(*b*) To engage front driving axle, the clutch pedal should be depressed to facilitate shifting. Pull the transfer front wheel drive gearshift lever (figs. 6 and 7) to the rear or IN position.

(c) To disengage the front driving axle, depress clutch pedal to facilitate shifting. Push the transfer front wheel drive gearshift lever to the forward or OUT position.

(2) *Selection of transfer LOW or HIGH range speeds.*

(*a*) For normal operations, transfer direct and underdrive gearshift lever (figs. 6 and 7) will be in the rear or HIGH position (fig. 4). With the gearshift lever in this position, the vehicle may be operated as either two or four wheel drive.

(*b*) To shift transfer to LOW range position, move the transfer direct and underdrive gearshift lever forward, and move transfer front wheel drive gearshift lever to the rear to engage front driving axle.

(*c*) Whenever possible, halt the vehicle prior to shifting the transfer to LOW range position. When shifting transfer from LOW to HIGH range or from HIGH to LOW range, depress clutch pedal to facilitate shift and gear engagement. In some cases, when shifting the transfer gearshift levers, it may be necessary to "double clutch" (*c* above).

(*d*) To shift transfer to HIGH range position, move the transfer direct and underdrive gearshift lever to the rear or HIGH position. Independent selection of axle drive may be made as desired.

e. Stopping the Vehicle.

(1) When stopping the vehicle, foot should be removed from the accelerator pedal before anticipated stopping point is reached. Application of service brake pedal should be made at a distance, in accordance with vehicle speed, to avoid sudden jerking stops which apply sudden loads and strains on brake system and vehicle.

(2) When a stop is anticipated, release foot from accelerator pedal and move it to service brake pedal (figs. 6 and 7). Apply brakes by depressing service brake pedal. Brakes should be applied gently but firmly to avoid skidding tires and to bring vehicle to a smooth stop.

(3) When stopping vehicle on ice or slippery terrain, the brakes should be applied in a series of quick applications and releases, to increase traction qualities. Holding brakes applied on ice or slippery terrain will cause wheels to skid.

(4) When stopping a vehicle with a towed load, such as a trailer, the weight of the towed load should be considered and used to determine the distance needed for stopping. Stops should be made as easily and smoothly as possible to prevent "jack-knifing" the trailer and resultant damage to vehicle or trailer. If trailer is equipped with brakes with controls installed in the vehicle, trailer brakes should be applied first to straighten load out before before vehicle brakes are applied.

(5) When vehicle speed has been reduced to a stop, and engine has returned to idling speed, depress clutch pedal and move transmission gear shift lever to the "NEUTRAL" position (fig. 4).

(6) When vehicle is stopped completely, apply parking brake control handle with sufficient pressure to hold vehicle, and release clutch and brake pedal.

f. Parking the Vehicle.

(1) When parking the vehicle, make sure all switches are in the "OFF" position unless tactical situation requires otherwise.

(2) When parking on a hill or grade, make sure parking brake is applied and, if grade is extremely steep, chock front or rear wheels to prevent accidental movement of vehicle.

(3) Avoid parking vehicle in mud or water, if possible, to prevent damage to tires if freezing occurs.

(4) If parking in formation or line, leave ample space between vehicle to avoid bumping in maneuvers and damage to vehicle.

g. Reversing the Vehicle.

(1) Before attempting to reverse the vehicle, bring the vehicle to a complete stop and make sure the area behind is clear. If vision to the rear is obscured, station someone outside to direct reversing operation.

(2) Allow engine to return to idle speed and depress clutch pedal. Move transmission gear shift lever to the left and forward to the reverse position.

(3) Release the clutch pedal slowly and at the same time depress the accelerator pedal. As the load is picked up, accelerate engine to move vehicle at desired speed.

Caution.—Do not attempt to drive vehicle at excessive speeds in reverse gear as loss of control is easily accomplished.

h. Stopping the Engine. After the vehicle is at a complete stop and the engine has returned to idling speed, turn the ignition switch (fig. 6) counterclockwise to the OFF position.

i. Use of Lights.

(1) *Operation of light switch.*

(*a*) Off position. When main switch lever (fig. 9) is in vertical or OFF position, all vehicle lights are off.

(*b*) *Blackout marker position.* When the main switch lever is turned to the left to the "BO MARKER" position (fig. 9), circuits for the blackout marker lights, blackout stop light, and blackout taillights are energized. The auxiliary switch lever (fig. 9) can be turned up to either dim or bright instrument panel light position. The mechanical switch lever must be held in the up position to move main switch lever.

(*c*) *Blackout drive position.* When main switch lever is turned to the left to "BO DRIVE" position (fig. 9), the circuits for the blackout driving light is energized as well as circuits for blackout marker lights, blackout stop lights, and blackout taillights. The mechanical switch lever (fig. 9) must be held in the up or unlocked position to turn main switch lever from "BO MARKER" to "BO DRIVE." The auxiliary switch lever can be turned up for bright or dim panel lights.

(*d*) *Stop light position.* The mechanical switch lever must be held in raised or unlocked position while main switch lever is being placed into "STOP LIGHT" position (fig. 9). This switch position is used for daylight driving. Left service stop light will illuminate when service brake pedal is applied.

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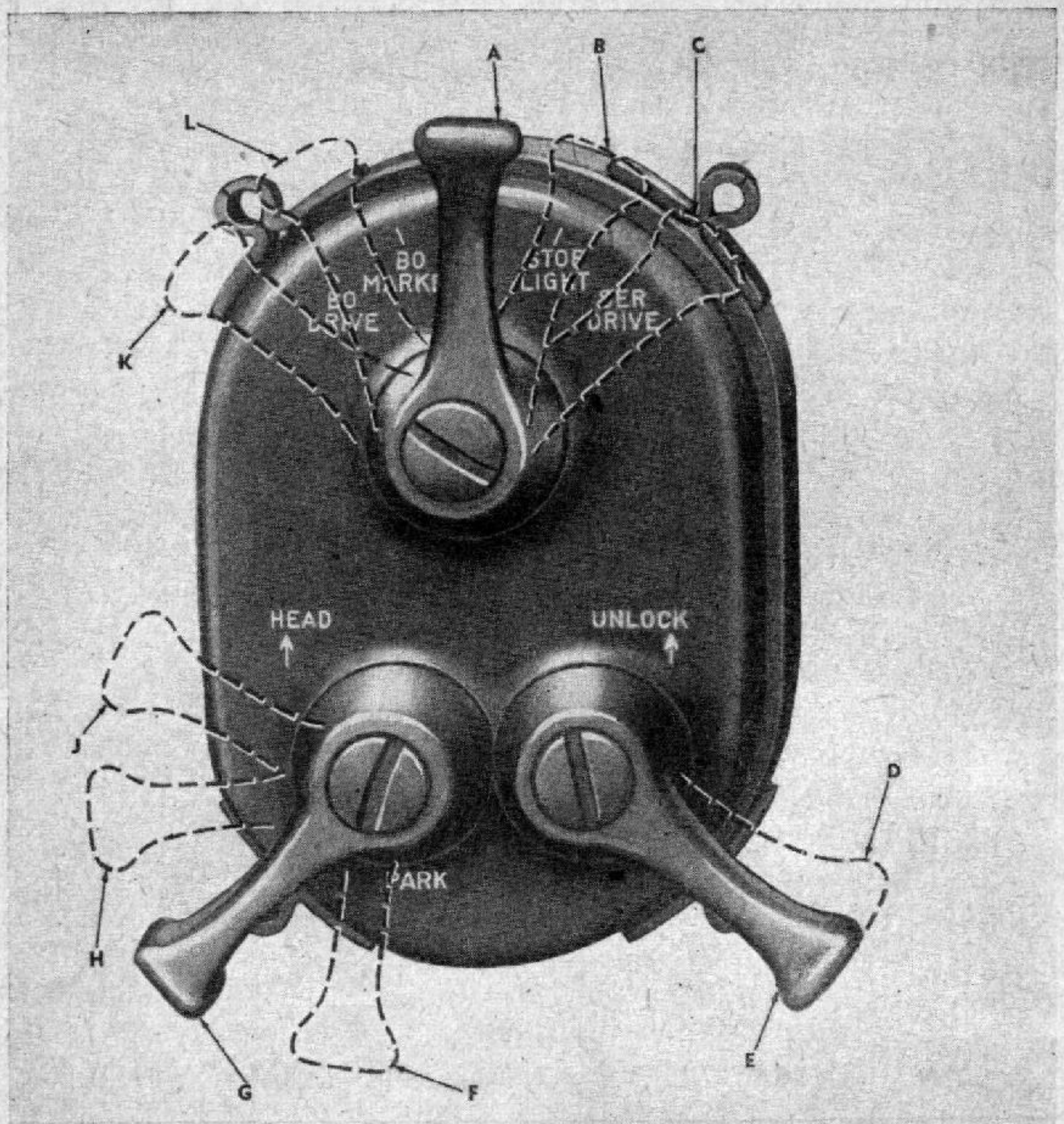

A—MAIN SWITCH LEVER
B—MAIN SWITCH LEVER—STOP LIGHT POSITION
C—MAIN SWITCH LEVER—SERVICE DRIVE POSITION
D—MECHANICAL SWITCH LEVER—UNLOCKED POSITION
E—MECHANICAL SWITCH LEVER
F—AUXILIARY SWITCH LEVER—PARK POSITION
G—AUXILIARY SWITCH LEVER
H—AUXILIARY SWITCH LEVER—DIM PANEL LIGHTS POSITION
J—AUXILIARY SWITCH LEVER—BRIGHT PANEL LIGHTS POSITION
K—MAIN SWITCH LEVER—BLACKOUT DRIVE POSITION
L—MAIN SWITCH LEVER—BLACKOUT MARKER POSITION

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Figure 9. Light switch positions.

(*e*) *Service drive position.* The mechanical switch lever must be held in raised or unlocked position while main switch lever is being placed into "SER DRIVE" position (fig. 9) from OFF. Main switch lever cannot be placed into "SER DRIVE" position from "STOP LIGHT" position without raising mechanical switch lever. When main switch lever is in "SER DRIVE," right and left service headlights and left service tail light are illuminated. Left service stop light will illuminate when brake pedal is applied.

(*f*) *Parking position.* After main switch lever is placed into "SER DRIVE" position, auxiliary switch lever can be positioned into "PARK" (fig. 9) to illuminate right and left front parking lights and left service taillight. Instrument panel lights are dim with auxiliary switch lever in "PARK" position. With main switch lever remaining in "SER DRIVE," auxiliary switch lever can be placed in OFF, or instrument panel light positions to again illuminate panel lights.

(*g*) *Instrument panel lighting.* With main switch lever in any position except OFF, auxiliary switch level (fig. 9) can be turned to left from OFF to first position for dim panel lights or to second position for bright panel lights.

(2) *Dimmer switch.* The foot operated dimmer switch (fig. 6) is used to control the high and low beams of the service driving lights. When high beam is being used, head light beam indicator light (fig. 6) will illuminate.

(3) *Trailer electric receptacle* (fig. 10). The trailer electric receptacle located at the left corner of the body is interconnected with the light switch. The light switch positions control blackout and service lights on the trailer in the same manner as controlled on the vehicle ((1) (*b*) above). Lift

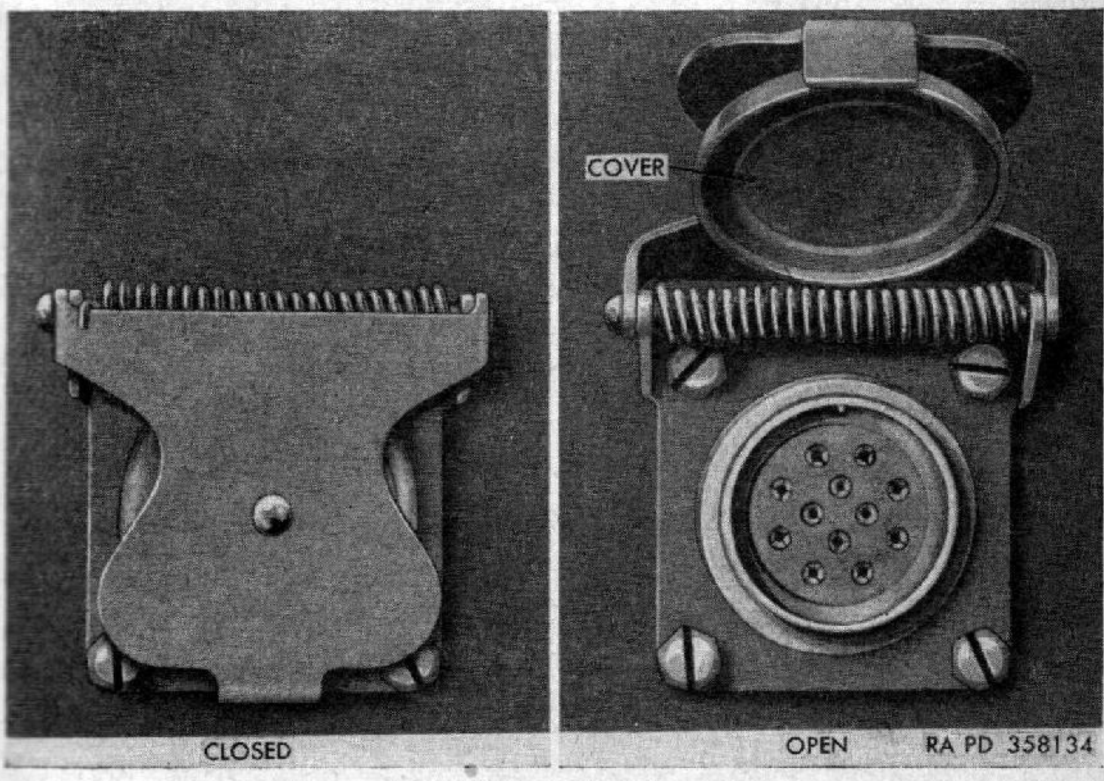


Figure 10. Trailer electric receptacle.

up trailer electric receptacle cover and plug trailer coupling cable into trailer electric receptacle. A clip on trailer electric receptacle cover, holds trailer coupling cable in place in the receptacle.

42. Towing the Vehicle

a. Towing To Start Engine. In case of emergency the engine can be started either by pushing or towing the vehicle; however, succeeding instructions must be carefully followed to avoid damage to transmission.

(1) Place transfer direct and underdrive gearshift lever of towed vehicle in "HIGH" gear range position and transfer front wheel drive gearshift lever in "OUT" position.

(2) Depress clutch pedal and place transmission gearshift level in high (third) gear.

(3) Turn ignition switch on, pull out choke control (if engine is cold), pull throttle control out approximately 1 inch, and release parking brake control handle.

(4) Move towing vehicle slowly until all slack is taken up in cable between towed and towing vehicles; then tow vehicle.

(5) After vehicle is under way, release clutch pedal slowly and depress accelerator pedal slightly. As engine starts, depress clutch pedal and return transmission gearshift lever to neutral. Regulate choke and throttle control as engine warms up.

Caution.—Exercise care not to overrun the towing vehicle or towing cable.

b. Towing a Disabled Vehicle. When towing a disabled vehicle, exercise care so that no further damage will occur.

(1) *Towing vehicle with all four wheels on the ground.*

(*a*) If transfer is not damaged, shift transmission and transfer into neutral positions and proceed as in (*c*) and (*d*) below.

(*b*) If transfer is damaged, disconnect both front and rear propeller shafts (par. 167) at the axle flanges, being careful not to lose any parts. Securely fasten propeller shaft to frame with wire, or remove dust cap and pull propeller shaft apart at splines. Take care in placing all propeller shaft parts in a safe place to prevent loss.

(*c*) If the front axle differential or propeller shaft is damaged, remove front axle driving flanges (fig. 104). Place transfer front wheel drive gearshift lever in ON position and vehicle may be driven under its own power.

(*d*) If the rear axle differential or propeller shaft is damaged, remove rear propeller shaft at rear universal joint **U** bolts (par. 167. Remove front universal joint snap rings (par. 167), in forward flange; then drive out universal joint bearings. Place transfer front wheel drive gearshift lever in IN position. This will allow the vehicle to be driven under its own power through the front driving axle.

(*e*) If only rear propeller shaft is damaged, remove propeller shaft (par. 167).

(*f*) If the vehicle has faulty brakes, do not attempt to tow with cable. A tow bar must be used to prevent the possibility of the towed vehicle overrunning the towing vehicle. When towing always use the pintle hook, clevises, or tow hooks provided on the vehicle.

(2) *Towing vehicle with front or rear wheels off ground.*—If vehicle is damaged to the extent that towing must be accomplished with either the front or rear wheels off the ground, make sure that the transfer direct and underdrive gearshift lever and transmission gearshift lever are in "NEUTRAL" and that the transfer front wheel drive gearshift lever is in the OUT position.

c. Use of Pintle Hook (fig. 11). The pintle hook is located at the rear of the vehicle and is the prime means of attaching a trailer, towing cable, or towing bar. To open pintle hook, pull pintle hook latch to the rear and, at the same time, pull up on pintle hook lock. To close pintle hook, push down on pintle lock.

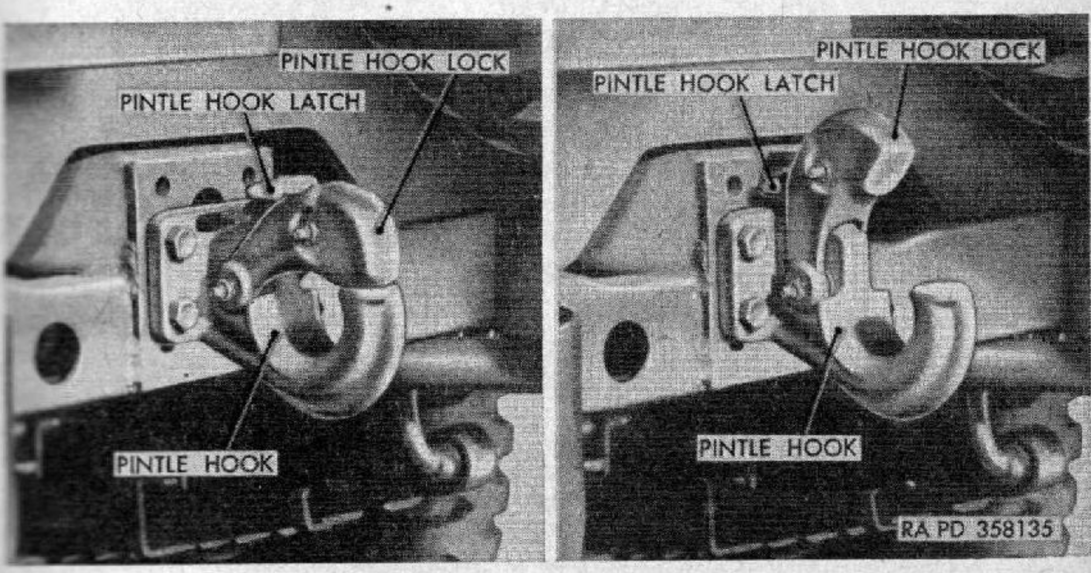


Figure 11. Pintle hook operating positions.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

43. General Conditions

a. In addition to the operating procedures described for usual conditions, special instructions of a technical nature for operating and servicing this vehicle under unusual conditions are contained or referred to herein. In addition to the normal preventive maintenance service, special care in cleaning and lubrication must be observed where extremes of temperature, humidity, and terrain conditions are present or anticipated. Proper cleaning, lubrication, and storage and handling of fuels and lubricants not only insure proper operation and functioning, but also guard against excessive wear of the working parts and deterioration of the materials.

b. TM 21–300 contains very important instructions on driver selection, training, and supervision and TM 21–305 prescribes special driving instructions for operating wheeled vehicles under unusual conditions.

Caution.—It is imperative that the approved practices and precautions be followed. A detailed study of these technical manuals is essential for use of this matériel under unusual conditions.

c. Refer to paragraph 55 for lubrication under unusual conditions, to table II and table III for preventive maintenance checks, and to paragraphs 209 through 211 for maintenance procedures.

d. When chronic failure of matériel results from subjection to extreme conditions, report of the condition should be made on DA Form 468.

44. Extreme-Cold Weather Conditions

a. General Problems.

(1) Extensive preparation of matériel scheduled for operation in extreme-cold weather is necessary. Generally, extreme cold will cause lubricants to thicken or congeal, freeze batteries or prevent them from furnishing sufficient current for cold weather starting, crack insulation and cause electrical short circuits, prevent fuel from vaporizing and properly combining with air to form a combustible mixture for starting, and will cause the various construction materials to become hard, brittle, and easily damaged or broken.

(2) The cooling system should be prepared and protected for temperatures below +32° F. in accordance with instructions given in TM 9–2855 on draining and cleaning the cooling

system and the selection, application, and checking of antifreeze compounds to suit the anticipated conditions.

(3) TM 9–2855 also describes the method of correcting specific gravity readings for batteries exposed to extreme cold.

(4) For description of operations in extreme cold, see FM 31–70, and FM 31–71, and TM 9–2855.

Caution.—It is imperative that the approved practices and precautions be followed. TM 9–2855 contains information which is specifically applicable to this vehicle as well as to all other vehicles. It must be considered an essential part of this manual, not merely an explanatory supplement to it.

b. Winterization Equipment. Special equipment is provided for the vehicle when protection against extreme-cold weather (0° to −65° F.) is required. This equipment is issued as specific kits. Each kit contains a technical bulletin which provides information on description, installation instructions, and methods of use. TM 9–2855 contains general information on winterization equipment and processing.

c. Fuels, Lubricants, and Antifreeze Compounds (Storage, Handling, and Use).

(1) The operation of equipment at arctic temperatures will depend to a great extent upon the condition of the fuels, lubricants, and antifreeze compounds used in the equipment. Immediate effects of careless storage and handling or improper use of these materials are not always apparent, but any deviation from proper procedures may cause trouble at the least expected time.

(2) In arctic operations, contamination with moisture is a source of many difficulties. Moisture can be the result of snow getting into the product, condensation due to "breathing" of a partially filled container, or moisture condensed from warm air in a partially filled container when a product is brought outdoors from room temperature. Other impurities will also contaminate fuels and lubricants so their usefulness is impaired.

(3) Refer to TM 9–2855 for detailed instructions on storage, handling, and use.

45. Extreme-Cold Weather Operation

a. General.

(1) The mechanical steps in operating the vehicle generally are the same as in operation under moderate temperature conditions (ch. 2).

(2) The driver must always be on the alert for indications of the effect of cold weather on the vehicle.

(3) The driver must be very cautious when placing the vehicle in motion after a shut-down. Congealed lubricants may cause failure of parts. Tires frozen to the ground or frozen to the shape of the flat spot when underinflated must be considered. One or more brake shoes may be frozen fast and require preheating to avoid damage to the mating surfaces. After warming up the engine thoroughly, place transmission in first gear, transfer in low range, and engage front driving axle (par. 41*d*(1)). Drive vehicle slowly approximately 100 yards, being careful not to stall the engine. This will heat gears and tires to a point where normal operation can be expected.

(4) Constantly note instrument readings. If any instrument reading consistently deviates from normal, stop the vehicle and investigate cause. A special engine thermostat provided in the arctic winterization kit opens at 180° F., and at this temperature the engine will give best results. If engine temperature gage readings consistently exceeds 200° F., adjust flap on radiator winterfront cover to admit more air.

b. At Halt or Parking.

(1) When halted for short shut-down periods, the vehicle should be parked in a sheltered spot out of the wind. If no shelter is available, park so that the vehicle does not face into the wind. For long shut-down periods, if high ground is not available, prepare a footing of planks or brush. Chock in place if necessary.

(2) When preparing a vehicle for shut-down periods, place all control levers in neutral position to prevent them from possible freezing in an engaged position. Freezing may occur when water is present due to condensation.

(3) Clean all parts of vehicle of snow, ice, and mud as soon as possible after operation. Refer to table II for detailed after-operation procedures. If the winter front cover is not installed, be sure to protect all parts of the engine and engine accessories against entrance of loose, drifting snow during the halt. Snow flurries penetrating the engine compartment may enter the crankcase filler vent, etc. Cover and shield the vehicle but keep the ends of the canvas paulins off the ground to prevent them from freezing to the ground.

(4) If no power plant heater is available, the battery should be removed and stored in a warm place.

(5) Refuel immediately in order to reduce condensation in the fuel tank. Prior to refueling, open fuel tank drain and drain off any accumulated water.

(6) When the vehicle is equipped with a power plant heater as provided by the arctic winterization kit, start the heater and check to be sure that it is operating effectively. The heater should avoid the necessity of removing the battery to warm storage, and is designed to operate unattended during overnight stops. Instructions for operation of winterization equipment will be found in pamphlet packed with the kit.

(7) Correct tire inflation pressure is prescribed in paragraph 211.

(8) When drain plugs have been removed or drain cocks opened to remove liquid from the cooling system of any equipment, the drains will be inspected to be sure none are obstructed. If the drain hole has become obstructed by foreign material, a soft wire should be used to clear the hole of the obstruction. This is particularly important before leaving a vehicle that has had the engine drained to protect the block from freezing. The draining of an engine cooling system to prevent freezing will be done only when no approved antifreeze solution is available.

46. Operation In Extreme-Hot Weather Conditions

a. General. Continuous operation of the vehicle at high speeds or long hard pulls in low gear positions on steep grades or in soft terrain may cause the vehicle to register overheating. Avoid the continuous use of low gear ratios whenever possible. Continuously observe engine temperature and halt the vehicle for a cooling-off period whenever necessary and the tactical situation permits. Frequently inspect and service engine cooling system (par. 121), engine oil filter (par. 90), and carburetor air cleaner (par. 107). If engine temperature consistently rises above 200° F., look for dust, sand, or insects in radiator fins and blow out any accumulation with compressed air or water under pressure. Flush cooling system if necessary (par. 121).

b. At Halt or Parking.

(1) Do not park the vehicle in the sun for long periods, as the heat and sunlight will shorten the life of the tires. If possible, park vehicle under cover to protect it from sun, sand, and dust.

(2) Cover inactive vehicles with paulins if no other suitable shelter is available. Where entire vehicle cannot be covered,

protect windshield glass against sand etching, and protect engine compartment against entry of sand.

(3) Correct tire inflation pressure is prescribed in paragraph 211.

(4) Vehicles inactive for long periods in hot humid weather are subject to rapid rusting and accumulation of fungi growth. Make frequent inspections and clean and lubricate to prevent excessive deterioration.

(5) Exterior surfaces which are not painted should be coated with a light film of engine lubricating oil.

47. Operation On Unusual Terrain

a. General.

(1) Vehicle operation on snow, ice, and in deep mud requires the use of tire chains on all driving wheels. Tire chains must be installed in pairs (front and rear) to prevent power train damage and wear. Select a gear ratio low enough to move vehicle steadily and without imposing undue driving strain on engine and power train. However, racing of the engine for extended periods must be avoided. Use front axle drive and tire chains at once if depth of mud or snow warrants. If good traction is assured, use "low range" transfer speed and suitable transmission speed. Return transfer to "high range" as soon as vehicle speed is adapted to independent transmission speed ratios. Care must be exercised that spinning wheels of a halted vehicle do not bury sufficiently to cause the vehicle axle housing to rest on the surface of the mud or snow.

(2) Operators must at all times know the position at which the front wheels are steering, as the vehicle may travel straight ahead even though the wheels are cramped right or left. A piece of string tied to the front portion of the steering wheel rim in "straight-ahead" position will indicate to the driver whether the front wheels are "ploughing." This ploughing action may cause the vehicle to stall or suddenly veer to right or left.

(3) If one or more wheels become mired or begin to spin, it may be necessary for the vehicle to be winched or towed by a companion vehicle or to jack up the mired wheel and insert planking or matting beneath it. Do not jam sticks or stones under a spinning wheel, as this only forms an effective block and will wear the tire tread unnecessarily.

(4) Skidding and the loss of steering and torque traction are the

chief difficulties encountered on icy roads. When rear end skidding occurs, instantly turn front wheels in the same direction that the rear end is skidding. Decelerate the engine and do not declutch. Apply brakes very gradually.

(5) Lowering of tire pressure in cases of sand, ice, mud, and snow will help to increase traction if tire chains are not available.

Note.—Do not lower tire pressure to the extent that damage will result.

(6) When negotiating hard baked sand, avoid breaking through crust. A road bed or canvas or planking is suitable on short stretches to insure against this possibility.

(7) Operation in sand or dust requires daily cleaning of carburetor air cleaner and engine oil filter. Engine vents and other exposed vents should be covered with a cloth.

(8) At high altitudes, coolant in vehicles boils at proportionately lower points than 212° F., therefore, it will be necessary to keep a close watch on the engine temperature during the summer months.

b. After-Operation Procedures. Clean all parts of the vehicle of snow, ice, mud, dust, and sand as soon as possible after operation. Particular care should be taken to remove collections of ice, snow, and mud from the wheels, radiator core, engine compartment, steering knuckles and arms, brakes, and hoses, crankcase breathers, carburetor air cleaner, and all control and electrical connections. ***Caution.***—Carefully remove accumulations of ice, caked mud, etc., from under fenders and where accumulated.

48. Fording Operations

a. General. In fording, vehicles may be subjected to water varying in depth from only a few inches to a depth sufficient to completely submerge the vehicle. Factors to be considered are spray-splashing precautions, normal fording capabilities, deep-water fording using fording kits, and accidental complete submersion.

b. Normal Fording. Fording of bodies of water up to maximum vehicle fording depth of 37½ inches is based on the standard vehicle with normal water proofing protection provided for critical units when manufactured, but without deep water fording kits. Observe the following precautions:

(1) Engine must be operating at maximum efficiency.

(2) Brake master cylinder must be filled to reduce the entrance of water.

(3) Do not exceed the known fording limits of the vehicle (par. 6).

(4) Engage front axle drive. Shift transmission to low (first) and shift transfer to "low range." Close control valve for crankcase ventilating system. Speed up the engine to overcome the possibility of a "stall" when the cold water chills the engine. Enter water slowly. Should the engine stall while submerged, it may be started in the usual manner (par. 40).

(5) All normal fording should be at speeds of from 3 to 4 mph to avoid forming a "bow wave." Keep at sufficient distance to avoid catching waves from preceding vehicles. Avoid using the clutch if possible because frequent use while submerged may cause the clutch to slip. If the ford is deep enough to cause spinning fan blades to catch water, loosen fan belt before crossing (par. 124); otherwise they may throw water on the electrical units. The brakes will be usually "lost" but in some cases may "grab" after emergence. Applying the brakes a few times after dry land has been reached, will help dry out the brake linings.

(6) If accidental complete submersion occurs, the vehicle will be salvaged, temporary precautions applied (par. 224) and then sent to the ordnance maintenance unit as soon as possible for necessary permanent maintenance.

c. Deep-Water Fording. Refer to TM 9–2853 for general information, descriptions, and methods of use of deep-water fording kits, and for general procedures for the operation of vehicles so equipped.

d. After-Fording Operations. Immediately after vehicle emerges from the water, push in the crankcase ventilator valves control (fig. 6), mounted on the instrument panel to allow the crankcase ventilating system to operate normally and relieve crankcase pressure. Open all drain holes in body. Also, at the earliest opportunity, check engine oil level and check for presence of water in the crankcase. Heat generated by driving will evaporate or force out most water which has entered at various points. Also, any *small* amount of water which has entered the crankcase either through leakage or due to condensation will usually be dissipated by the crankcase ventilating system. Refer to paragraph 224 for maintenance operations after fording.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR ORGANIZATIONAL MAINTENANCE

49. General

Tools, equipment, and spare parts are issued to the using organization for maintaining the material. Tools and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored in the tool compartment and/or roll provided for them.

50. Parts

Spare parts are supplied to the using organization for replacement of those parts most likely to become worn, broken, or otherwise unserviceable providing such operations are within the scope of organizational maintenance functions. Spare parts, tools, and equipment supplied for the 1/4-ton 4 x 4 utility truck M38A1 are listed in Department of the Army Supply Catalog ORD 7 SNL G–758 which is the authority for requisitioning replacements.

51. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this matériel are authorized for issue to 1st echelon by ORD 7 SNL G–758. Common tools and equipment for 2d echelon are listed in ORD 6 SNL J–7, Sections 1, 2, 3, and 4; ORD 6 SNL J–10, Section 4, and are authorized for issue by T/A and T/O&E.

52. Special Tools and Equipment

Certain tools and equipment specially designed for organizational maintenance, repair, and general use with the material are listed in table I for information only. This list is not to be used for requisitioning replacements.

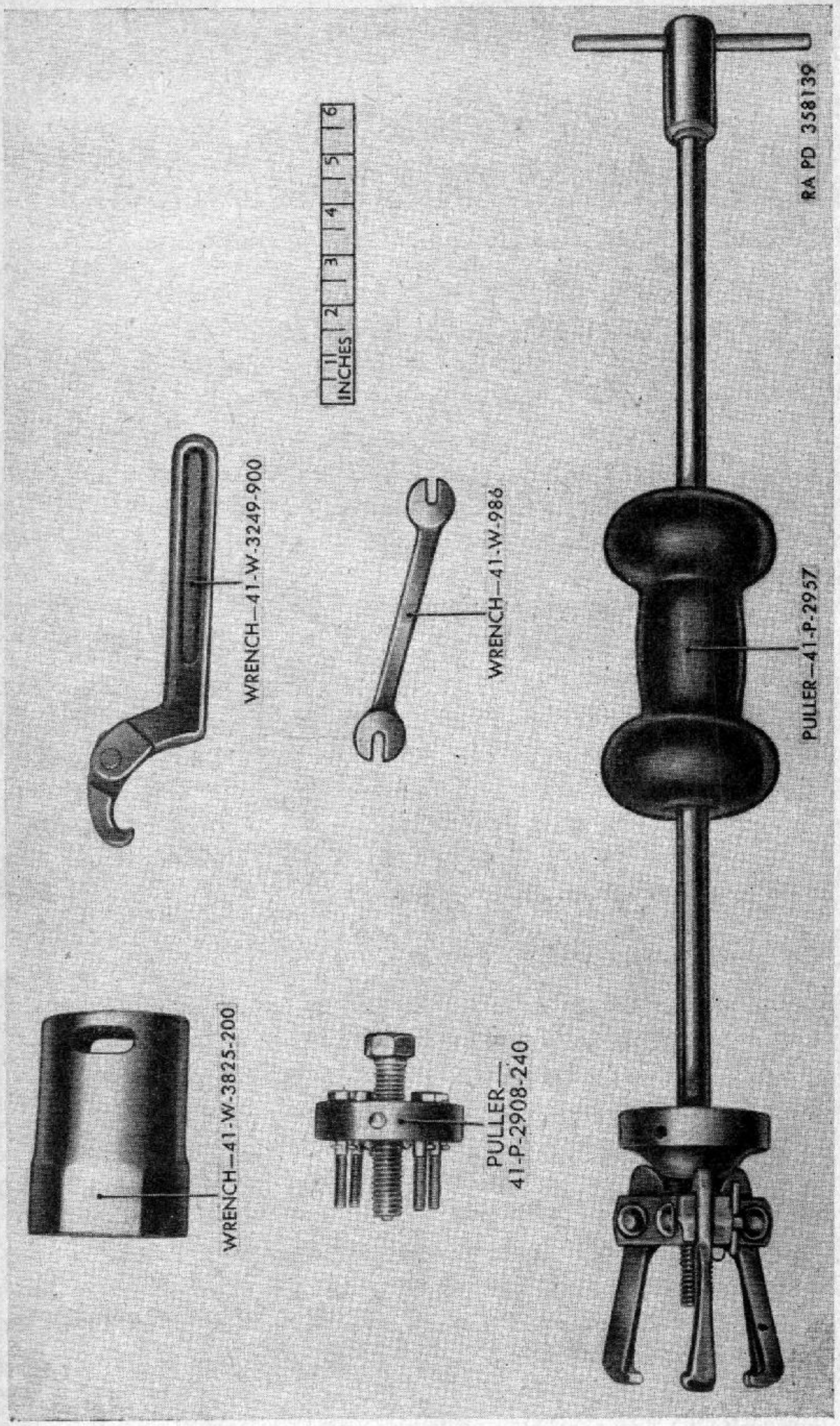


Figure 12. Special tools and equipment for organizational maintenance.

Table I.—Special Tools and Equipment for Organizational Maintenance

Item	Identifying number	References		Use
		Fig.	Par.	
PULLER, universal	41-P-2957	12, 104	174	Removing front wheel flange.
PULLER, water pump, drive pulley.	41-P-2908-240	12, 74	123	Removing water pump drive pulley.
TOOL, retaining transmission mainshaft.	7083128	97	160, 161	Retains position of mainshaft during removal of transmission from transfer.
WRENCH, engrs, angle 15 deg, dbl open end alloy-S, size of openings 5/16 and 1/4 in.	41-W-986	12, 112	191	Adjusting brakes.
WRENCH, spanner	41-W-3249-900	12, 70, 74	94, 96, 97, 118, 119, 145	Removing and installing electric coupling nuts.
WRENCH, wheel brg nut, sgle-end tubular, hex size of opng 2¼ in., lgh 3. 56 in.	41-W-3825-200	12, 105	174	Removing and installing wheel-bearing retainer nut.

Section II. LUBRICATION AND PAINTING

53. Lubrication Chart

The lubrication chart (figs. 13 and 14) prescribes cleaning and lubrication procedures as to locations, intervals, and proper materials for this vehicle.

Note.—The lubrication instructions illustrated in figures 13 and 14 furnish information on lubrication for this vehicle.

Lubrication which is to be performed by ordnance maintenance personnel is listed in figure 14.

54. General Lubrication Instructions

a. General. Any special lubricating instructions required for specific mechanism or parts are covered in the pertinent section.

b. Usual Conditions. Service intervals specified on the lubrication chart are for normal operation and when moderate temperature, humidity, and atmospheric conditions prevail.

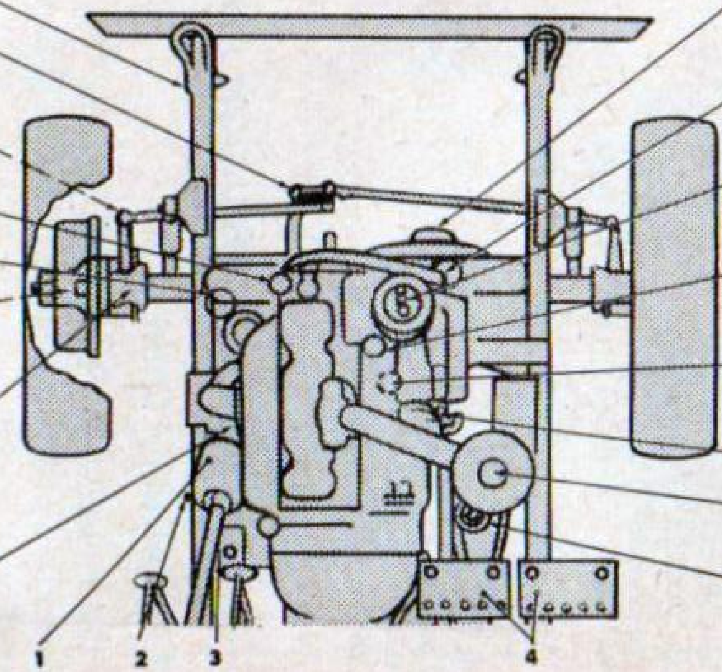
LUBRICATION CHART

TRUCK, ¼-TON, 4x4, UTILITY, M38A1

Intervals are based on normal operation. Reduce to compensate for abnormal operation, severe conditions or contaminated lubricants. During inactive periods, intervals may be extended commensurate with adequate preservation.

Clean fittings before lubricating. Relubricate after washing or fording. Clean parts with volatile mineral spirits (TPM) or SOLVENT, dry cleaning (SD). Dry before lubricating. Lubricate dotted arrow points on both sides of the equipment.

		Lubricant	Interval
AA, Fig 17	**Spring Pivot Bolt**	CG	1
E, F, Fig 15	**Tie Rod** (Inner)	CG	1
D, Fig 15	**Tie Rod** (Outer)	CG	1
B, Fig 15	**Steering Bellcrank**	CG	1
C, Fig 15	**Drag Link**	CG	1
BB, Fig 18	**Front Wheel Bearings** (Remove, clean and repack annually or every 12,000 miles)	WB	A
CC, Fig 18	**Universal Joint and Steering Knuckle Bearings** (See note 6)	CG	1
C, Fig 15	**Drag Link**	CG	1



Interval	Lubricant		
W	GO	**Front Differential Fill and Level** (Check level)	T, Fig 16
A		**Front Differential Drain** (Drain and refill. Cap. 2½ pts.) (See note 5)	S, Fig 16
D		**Oil Filter** (Turn handle one complete turn) (See note 3)	V, Fig 17
D	OE	**Crankcase Fill and Level** (Check level)	U, Fig 17
5		**Crankcase Drain** (Drain and refill. Cap. 5 qts.) (See note 2)	W, Fig 17
1	CG	**Universal Joint**	Q, Fig 16
D	OE	**Air Cleaner** (See note 1)	X, Fig 17
S		**Distributor** (See note 4)	EE, Fig 18

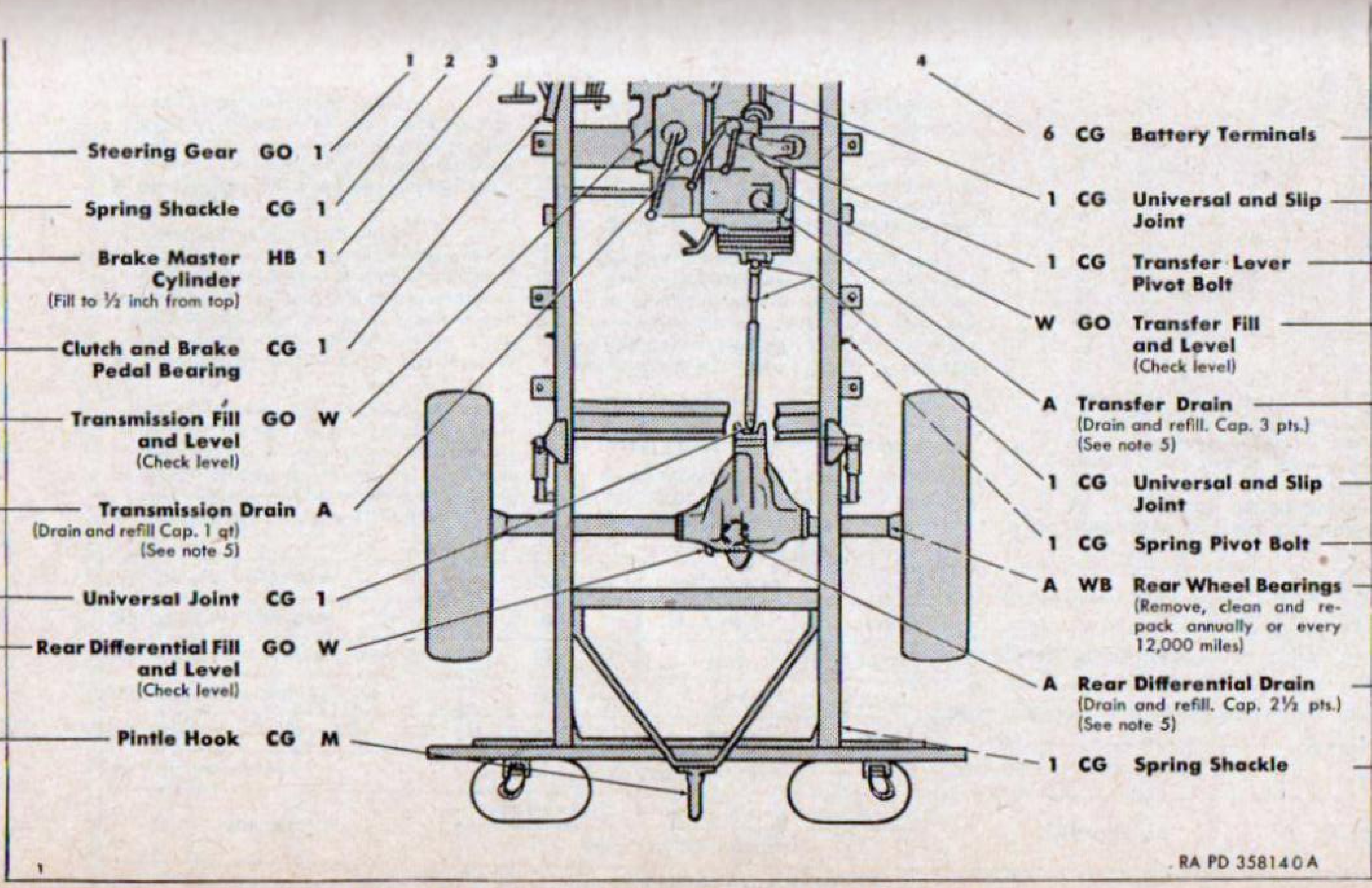


Figure 13. ¼-ton 4 x 4 utility truck M38A1 lubrication chart.

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KEY

LUBRICANTS	EXPECTED TEMPERATURES		
	above +32° F	+40° F to −10° F	0° F to −65° F
OE—OIL, lubr, engine	OE 30 or N.S. 9250	OE 10 or N.S. 9110	OES
GO—LUBRICANT, gear, universal	GO 90	GO 90	GOS
CG—GREASE, lubr, general purpose	CG 1	CG 0	OG 00
WB—GREASE, lubr, general purpose, No. 2	WB	WB	OG 00
HB—FLUID, hydraulic brake	HB	HB	HBA
PL—OIL, lubr, preservative	PL (Med)	PL (Special)	PL (Special)

LUBRICANTS
OES—OIL, lubr, engine, sub-zero
GOS—LUBRICANT, gear, universal, sub-zero
OG—GREASE, lubr, Ord Dept
HBA—FLUID, hydraulic brake, arctic

INTERVALS
D—Daily
W—Weekly
M—Monthly
S—Semiannually
A—Annually
1—1,000 Miles
6—6,000 Miles

NOTES

1. **AIR CLEANER**—(Oil Bath Type) Daily, replenish to bead level with OE, crankcase grade. Every 1,000 miles clean oil reservoir and refill. Every 6,000 miles, or semiannually, disassemble, clean all parts. For desert or extremely dusty operation, reduce interval to meet conditions.

2. **CRANKCASE**—Drain every 6,000 miles or semi-annually. Drain only when engine is hot. Refill to FULL mark. Run engine a few minutes, recheck level. For satisfactory operation on heavy duty engine oil, engine thermostat must be operating properly to maintain engine coolant temperature at +140° F minimum.

3 **OIL FILTER**—Every 1,000 miles, remove plug in bottom of case and drain sediment. Every 6,000 miles or semiannually, while crankcase is being drained, remove, clean and inspect element, clean inside of case, install element.

4. **DISTRIBUTOR**—Semiannually, wipe breaker cam lightly with CG and lubricate breaker arm pivot and wick under rotor with 1 to 2 drops of PL.

5. **GEAR CASES**—Drain every 12,000 miles or annually. Fill to plug levels before operation and after draining. Drain only after operation.

6. **UNIVERSAL JOINT AND STEERING KNUCKLE BEARINGS**—Every 1,000 miles, remove plug and fill to level. When wheels are removed for packing, remove steering knuckles, clean and repack universal joint housing. Do not disassemble constant velocity universal joint.

7. **OIL CAN POINTS**—Every 1,000 miles, lubricate hand brake linkage, clutch and brake pedal linkage, pintle hook if not equipped with fittings, with PL.

8. **DO NOT LUBRICATE**—Shock absorbers, springs, clutch release bearing, water pump.

9. **LUBRICATED AT TIME OF DISASSEMBLY BY ORDNANCE PERSONNEL**—Ventilator dual valve control, throttle control, choke control, steering column bearing (upper), generator, starter, clutch fulcrum ball, clutch release bearing carrier, clutch pilot bearing, hand brake cable, speedometer flexible shaft.

RA PD 358140B

Figure 14. ¼-ton 4 x 4 utility truck M38A1 lubrication chart.

c. Lubrication Equipment. Each vehicle is supplied with lubrication equipment adequate for its maintenance. Clean this equipment before and after use. Operate the lubrication guns carefully and in such a manner as to insure a proper distribution of the lubricant.

d. Points of Application.

(1) Lubrication fittings, grease cups, oilers, and oilholes are shown in figures 15 through 18 and are referenced to the lubrication order. Wipe these devices and the surrounding surfaces clean before and after lubricant is applied.

(2) A ¾-inch red circle should be painted around all lubricating fittings and oilholes.

(3) Clean and lubricate unsealed bearings as follows:

(*a*) Wash all of the old lubricant out of the bearings and from the inside of the hubs with volatile mineral spirits or dry-cleaning solvent and dry the parts thoroughly.

Caution.—Bearings must not be dried or spun with compressed air. See TM 37–265 for care and maintenance of bearings.

(*b*) Pack the bearings by hand or with a mechanical packer introducing the lubricant carefully between the rollers. Do not smear grease only on the outside of the bearings and expect it to work in. Great care must be exercised to insure that dirt, grit, lint, or other contaminants are not introduced into the bearings. If the bearings are not to be installed immediately after repacking, they should be wrapped in clean oilproof paper to protect them from contaminants.

(*c*) After the bearings are properly lubricated, pack the hub with a sufficient amount of lubricant to uniformly fill it to the inside diameters of the inner and outer bearing races. Coat the spindles and hub caps with a thin layer of lubricant (not over one-sixteenth of an inch) to prevent rusting. Do not fill the hub caps to serve as grease cups under any circumstances. They should be lightly coated however, to prevent rusting.

Note.—For normal operation, lubricate wheel bearings at 12,000 miles or at annual intervals, whichever comes first.

e. Reports and Records.

(1) Report unsatisfactory performance of prescribed petroleum fuels, lubricants, or preserving materials, using DA Form 468.

(2) Maintain a record of lubrication of the vehicle on DA Form 461.

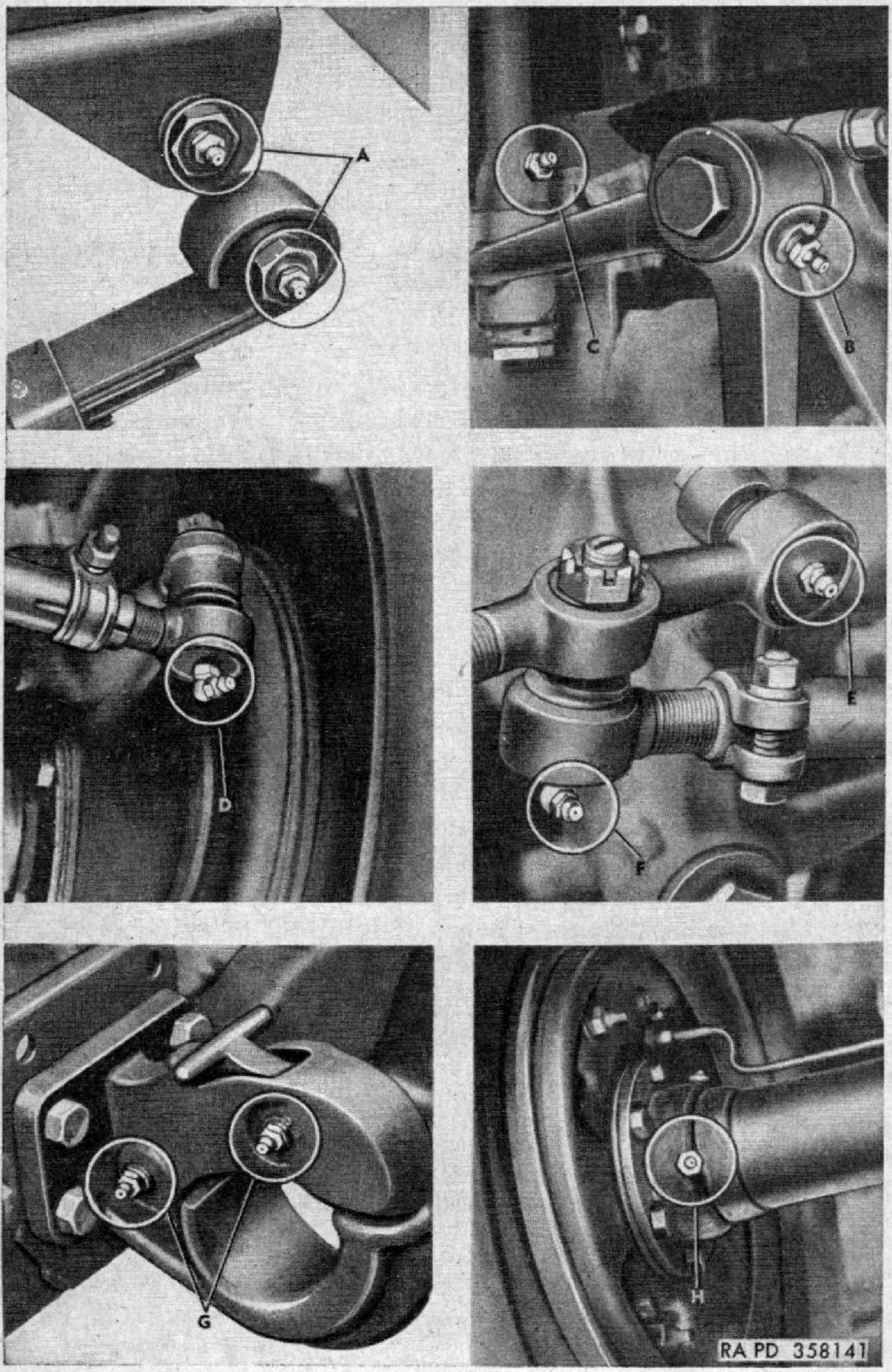


Figure 15. Localized lubrication points A through H.

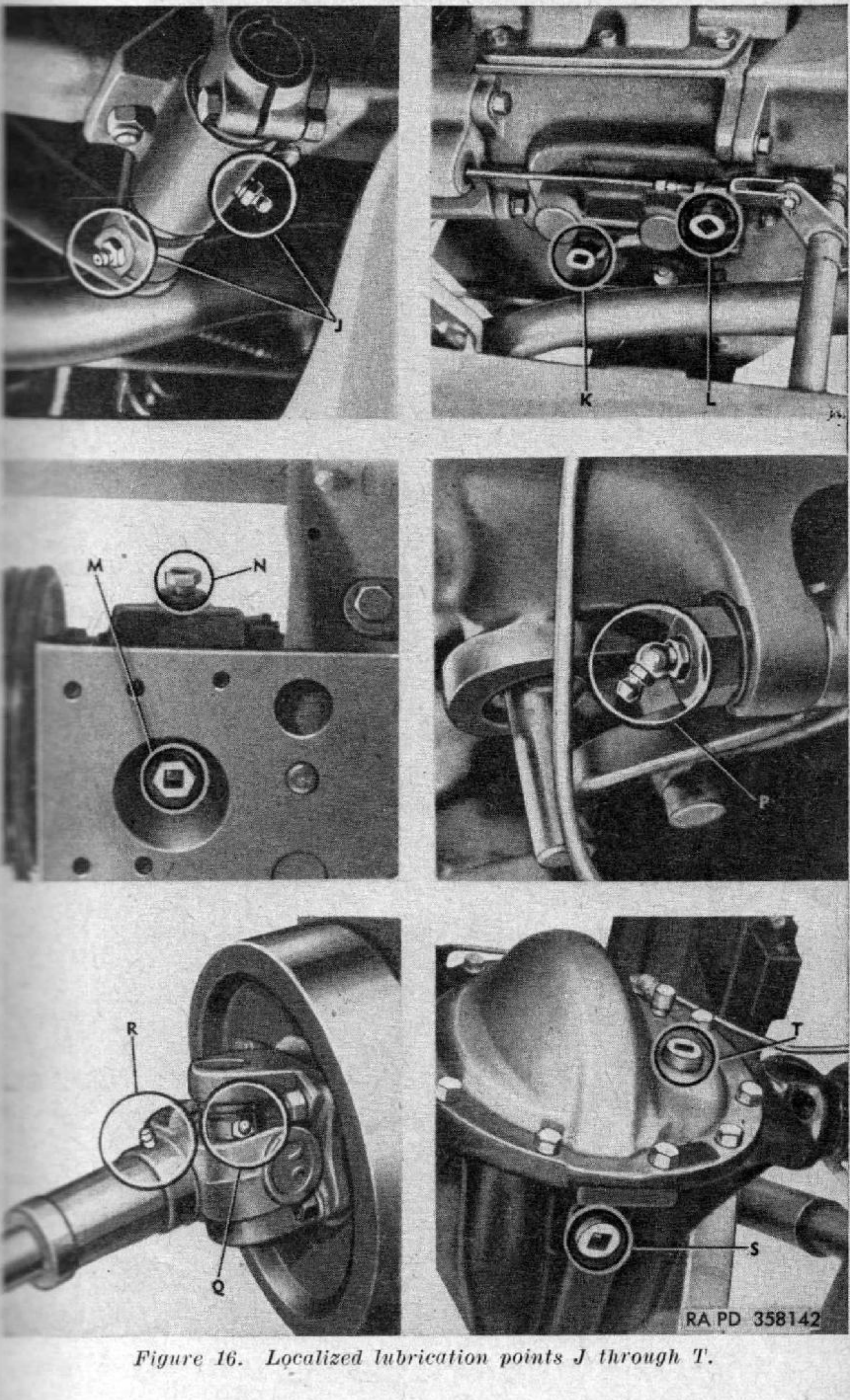


Figure 16. Localized lubrication points J through T.

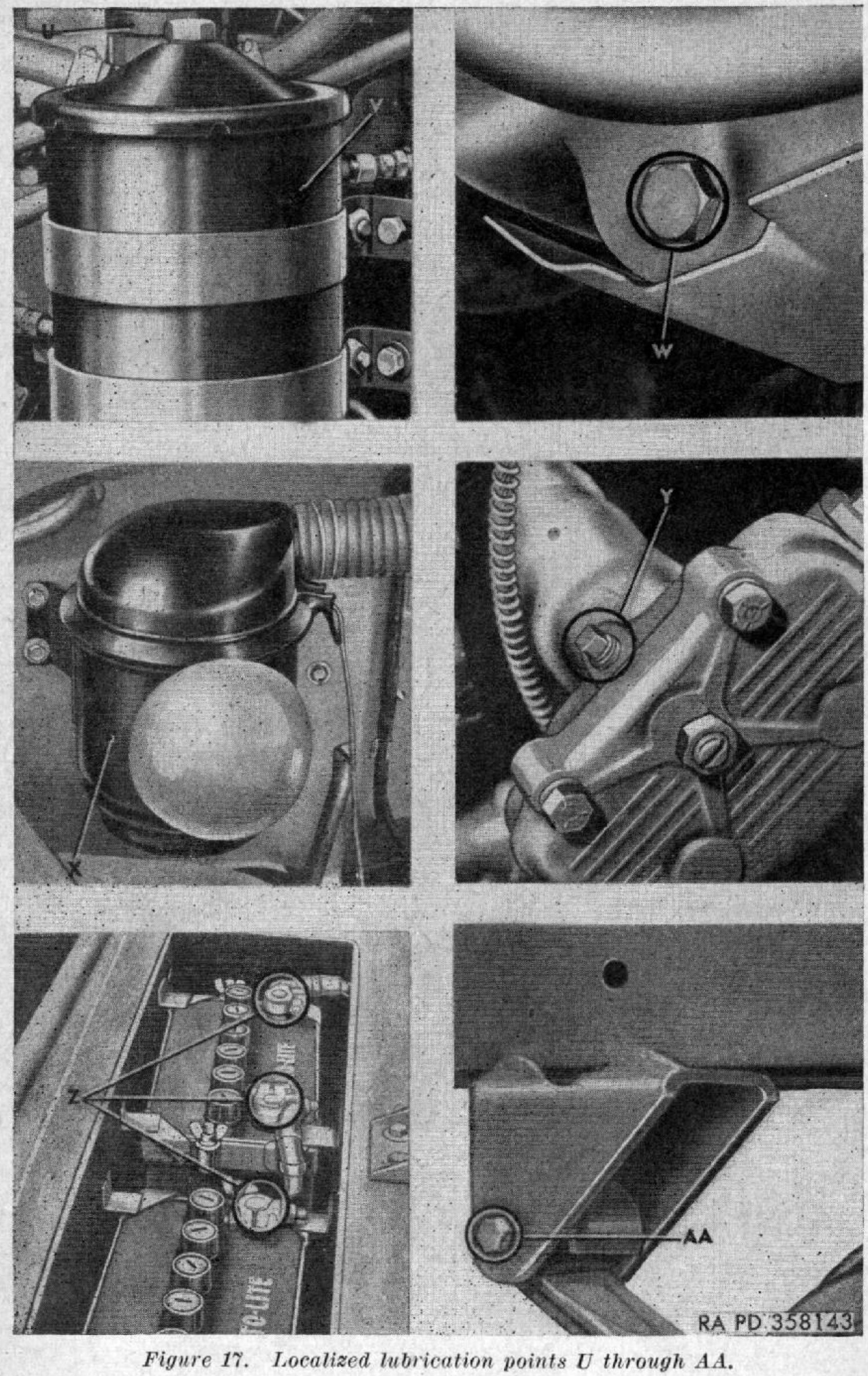


Figure 17. Localized lubrication points U through AA.

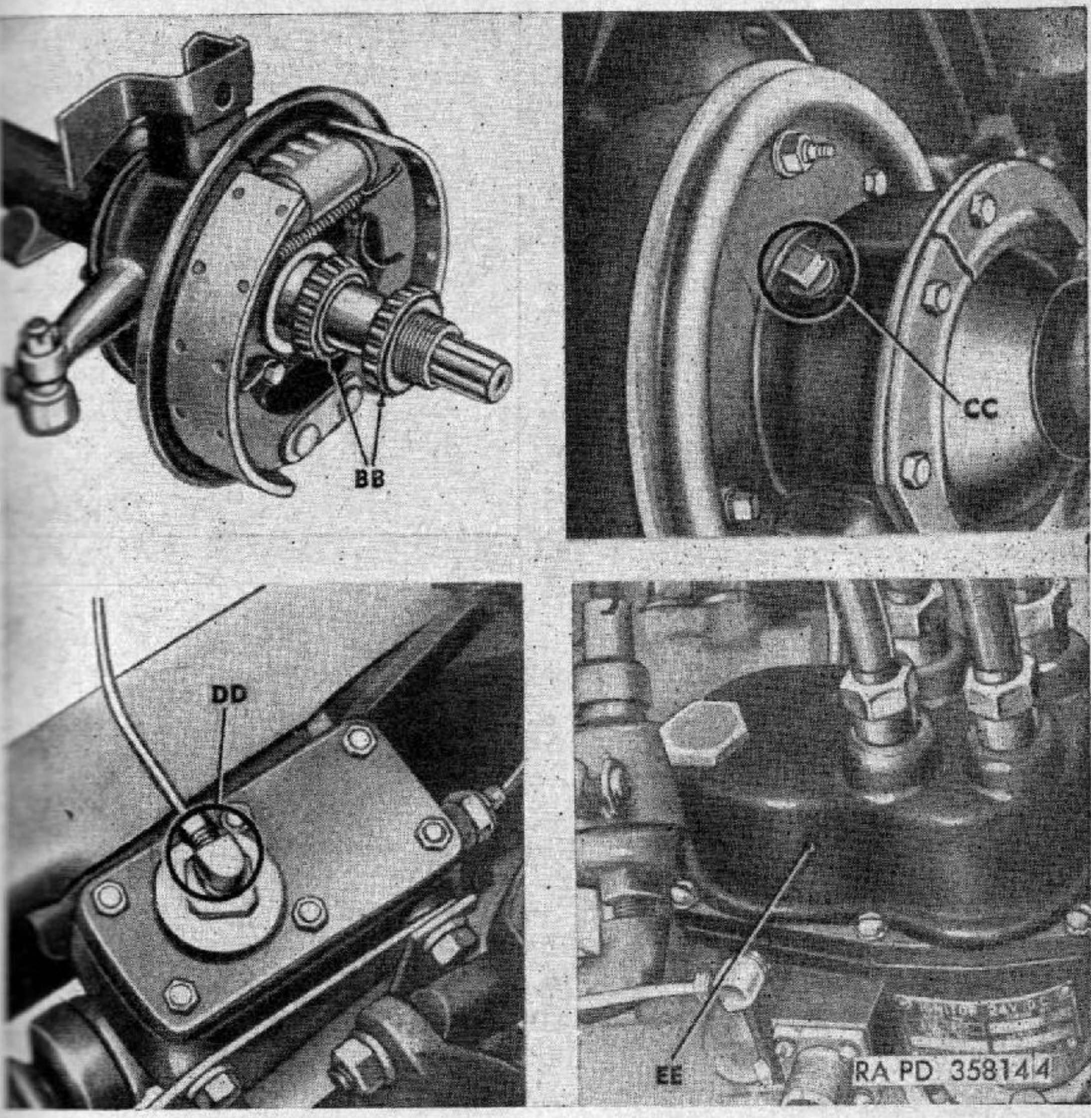


Figure 18. Localized lubrication points BB through EE.

55. Lubrication Under Unusual Conditions

a. Unusual Conditions. Reduce service intervals specified on the lubrication order, i. e., lubricate more frequently, to compensate for abnormal or extreme conditions, such as high or low temperatures, prolonged periods of high speed operation, continued operation in sand or dust, immersion in water, or exposure to moisture. Any one of these operations or conditions may cause contamination and quickly destroy the protective qualities of the lubricants. Intervals may be extended during inactive periods commensurate with adequate preservation.

Note.—Operation in mud requires that spring shackles and pivot bolts, propeller shafts, universal joints, and slip joints be lubricated immediately before and after such operation, and every 4 hours sustained operation under these conditions.

b. Changing Grade of Lubricants. Lubricants are prescribed in the "Key" in accordance with three temperature ranges; +32° F., +40° to −10° F., and from 0° to −65° F. Change the grade of lubricants whenever weather forecast data indicate that air temperatures will be consistently in the next higher or lower temperature range or when sluggish starting caused by thickening occurs. No change in grade will be made when a temporary rise in temperature is encountered.

c. Maintaining Proper Lubricant Levels. Lubricant levels must be observed closely and necessary steps taken, to replenish in order to maintain proper levels at all times.

56. Lubrication for Continued Operation Below 0° F.

Refer to TM 9–2855 for instructions on necessary special preliminary lubrication of the vehicle.

57. Lubrication After Fording Operations

a. After any fording operation, in water 12 inches or over, lubricate all chassis points to cleanse bearings of water or grit as well as any other points required in accordance with paragraph 224, for maintenance operations after fording.

b. If the vehicle has been in deep water for a considerable length of time or was submerged beyond its fording capabilities, precautions must be taken as soon as practicable to avoid damage to the engine and other vehicle components as follows:

(1) Perform a complete lubrication service (par. 53).

(2) Inspect engine crankcase oil. If water or sludge is found, drain the engine oil and flush the engine with preservative engine oil PE–30. Before putting in new engine oil, drain the oil filter and install a new filter element (par. 90).

Note.—If preservative engine oil is not available, engine lubricating oil OE–30 may be used.

(3) Operation in bodies of salt water enhances the rapid growth of rust and corrosion, especially on unpainted surfaces. It is most important to remove all traces of salt water and salt deposits from every part of the vehicle. For assemblies which have to be disassembled, dried, and relubricated, perform these operations as soon as the situation permits. Wheel bearings must be disassembled and repacked after each submersion. Regardless of the temporary measures taken, the vehicle must be delivered as soon as practicable to the ordnance maintenance unit.

58. Lubrication After Operation Under Dusty or Sandy Conditions

After operation under dusty or sandy conditions, clean and inspect all points of lubrication for fouled lubricants and relubricate as necessary.

Note.—A lubricant which is fouled by dust and sand makes an abrasive mixture that causes rapid wear of parts.

59. Painting

Instructions for the preparation of the material for painting, methods of painting, and material to be used are contained in TM 9–2851. Instructions for camouflage painting are contained in FM 5–20B.

Section III. PREVENTIVE MAINTENANCE SERVICES

60. General

a. Responsibility and Intervals. Preventive maintenance services are the responsibility of the using organization. These services consist generally of operator's services (before-operation, during-operation, at-the-halt, and after-operation) performed by the operator or crew; of leader's "A" services (weekly) performed by operator or crew under supervision of the squad or platoon leader; and of commander's "B" and "C" services performed at designated intervals by organizational maintenance personnel. Intervals are based upon normal operations. Reduce intervals for abnormal operations or severe conditions. Intervals during inactive periods may be extended accordingly.

b. Definition of Terms. The general inspection of each item applies also to any supporting member or connection and is generally a check to see whether the item is in good condition, correctly assembled, secure, and not excessively worn.

(1) The inspection for "good condition" is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits. The term "good condition" is explained further by the following: not bent or twisted, not chafed or burned, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, and not deteriorated.

(2) The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to see whether it is in its normal assembled position in the vehicle.

(3) Inspection of a unit to determine if it is "secure" is usually an external visual examination or a check by hand, wrench, or pry-bar for looseness. Such an inspection must include any brackets, lock washers, lock nuts, locking wires, or cotter pins used.

(4) By "excessively worn" is meant worn beyond serviceable limits or to a point likely to result in failure if the unit is not replaced before the next scheduled inspection.

61. Cleaning

a. General. Any special cleaning instructions required for specific mechanisms or parts are contained in the pertinent section. General cleaning instructions are as follows:

(1) Use dry-cleaning solvent or volatile mineral spirits to clean or wash grease or oil from all parts of the vehicle.

(2) A solution of one part grease-cleaning compound to four parts of dry-cleaning solvent or volatile mineral spirits may be used for dissolving grease and oil from engine blocks, chassis, and other parts. Use cold water to rinse off any solution which remains after cleaning.

(3) After the parts are cleaned, rinse and dry them thoroughly. Apply a light grade of oil to all polished metal surfaces to prevent rusting.

(4) Before installing new parts, remove any preservative materials, such as rust-preventive compound, protective grease, etc; prepare parts as required (oil seals, etc.); and for those parts requiring lubrication, apply the lubricant prescribed in the improvised lubrication chart (par. 53).

b. Name Plate. Name plates, caution plates, and instrument plates made of steel rust very rapidly. When they are found to be in a rusty condition, they should be thoroughly cleaned and heavily coated with an application of lacquer.

c. General Precautions in Cleaning.

(1) Dry-cleaning solvent and volatile mineral spirits are inflammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used. Use only in well ventilated places.

(2) These cleaners evaporate quickly and have a drying effect on the skin. If used without gloves, they may cause cracks in the skin and, in the case of some individuals, a mild irritation or inflammation.

(3) Avoid getting petroleum products, such as dry-cleaning solvent, volatile mineral spirits, engine fuels, or lubricants on rubber parts as they will deteriorate the rubber.

(4) The use of diesel fuel oil, gasoline, or benzene (benzol) for cleaning is prohibited.

62. Operator's and Leader's Preventive Maintenance Services

a. Purpose. To insure efficient operation, it is necessary that the vehicle be systematically inspected at intervals every day it is operated and also weekly so defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. Any defects or unsatisfactory operating characteristics beyond the scope of the driver or operator to correct must be reported at the earliest opportunity to the designated individual in authority.

b. Services. Operator's and leader's "A" preventive maintenance services are listed in table II. Every organization must thoroughly school its personnel in performing the maintenance procedures for this vehicle as set forth in this manual.

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At-the-halt	After operation		
					USUAL CONDITIONS
					Caution: Place all tags describing condition of vehicle in the driver's compartment in a conspicuous location so they will not be overlooked.;
X	-----	X	X	X	(1) *Fuel, oil, and water.* Check the amount of fuel in the fuel tank (par. 30) and note any indication of leaks. Add fuel if necessary (par. 106) and check the spare fuel containers. Check engine oil level and add oil if necessary. Check coolant level in the cooling system and note any indication of leaks. When water is added (par. 121) during period that antifreeze is in use, a hydrometer test must be made and antifreeze added, if necessary, to provide safe operation to meet lowest anticipated temperatures (TM 9–2855).
					(2) *Tires.*

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle—Continued

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At-the-halt	After operation		
					USUAL CONDITIONS—Continued
X	------	------	------	X	(*a*) Gage all tires, including spare, for correct pressure (par. 211).
		X	X	X	(*b*) Remove all penetrating objects such as nails or glass. Examine tires for signs of low pressure, abnormal tread wear, cuts, and presence of valve caps.
X	------	X	X	X	(3) *Leaks, general.* Look under the vehicle and in engine compartment for indications of fuel, engine oil, gear oil, or brake-fluid leaks.
					(4) *Vehicle equipment.*
X	------	------	------	------	(*a*) Make sure vehicle publications are present and in good condition.
X	------	------	X	X	(*b*) Operate lights, horn (if tactical situation permits), and windshield wipers. Visually inspect mirrors, reflectors, lights, body, towing connections, paulins, tools, etc.
				X	(*c*) Check for any tampering or damage that may have occured since last inspection.
X	X	------	------	------	(5) *Instruments.* Observe for normal readings during warm-up and during operation of vehicle. ***Caution:*** If engine oil pressure is zero or excessively low, stop engine immediately and investigate cause (par. 65).
	X	------	------	------	(6) *General operations.* While the vehicle is being operated be alert for any unusual noises or improper operation of steering, clutch, brakes, or gear shifting.
		X	X	X	(7) *Operating faults.* Investigate and correct or report any faults noted during operation.
		X	X	X	(8) *Springs and suspensions.* Look at springs and shock absorbers to see if they have been damaged.
			X	X	(9) *Lubricate.* Lubricate items specified on the lubrication order (par. 53).
					(10) *Clean.*
			X	X	(*a*) Clean glass and inside of vehicle. Wipe off exterior of vehicle.

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle—Continued

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At-the-halt	After operation		
					USUAL CONDITIONS—Continued
				X	(*b*) Wash vehicle. Clean engine and engine compartment.
				X	(11) *Battery.* Clean. Check water level. Inspect terminals for corrosion, tightness, and coating of grease.
				X	(12) *Assemblies and belts.* Inspect assemblies such as carburetor, generator, starter, coil, distributor, water pump and hoses for loose connections or mountings. Check adjustment of drive belts (par. 124).
				X	(13) *Electrical wiring.* Check all accessible electrical wiring, conduits, and shielding to see that it is securely connected and in good condition.
				X	(14) *Axle and transfer vents.* Inspect for clogging.
					UNUSUAL CONDITIONS
					Preventive maintenance services for usual conditions will apply with emphasis on servicing by the driver to combat the effects of unusual conditions of extreme cold, extreme heat, unusual terrain, and fording. The special services described below are those required to assure best results under unusual conditions.
					Note.—Data given for extreme-cold conditions is based on the assumption that the arctic winterization kit has been installed (TM 9-2855).
					EXTREME COLD (pars. 221 and 222 and TM 9–2855)
			X	------	(15) *Cooling and fuel systems.* Refuel (par. 106) and add denatured alcohol as required.
				X	(*a*) Drain fuel tank to remove condensation and sludge; refuel fuel tank (par. 106).

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle—Continued

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At-the-halt	After operation		
					UNUSUAL CONDITIONS—Continued *EXTREME COLD*—Continued
X	------	------	X	X	(*b*) Check level and check specific gravity of coolant in radiator, if using ethylene glycol and add ethylene glycol or water as needed (par. 121). *Note.*—If using arctic antifreeze compound, make a warning tag and place it on or near the filler neck. The tag should read: THIS COOLING SYSTEM IS FILLED WITH ARCTIC ANTIFREEZE COMPOUND. ***Caution:***—DO NOT ADD WATER OR ANY ETHYLENE GLYCOL-TYPE ANTIFREEZE. USE ARCTIC ANTIFREEZE COMPOUND ONLY.
				X	(16) *Lubricants.* Check and, if necessary, change lubricants and special oils to conform with the lubrication chart (par. 53).
				X	Check gear cases for collections of sludge and water and clean out if necessary and refill. *Note.*—It is necessary to have lubricant warm and fluid for draining and refilling.
		X	X	------	(17) *Control levers.* Position all control levers in neutral position.
X	------	X	------	------	(18) *Tires.* Check for tires frozen to ground or for frozen flat spots.
X	------	------	------	X	(*a*) Check for availability and serviceability of tire chains.
X	------	------	------	X	(*b*) Check for proper tire pressure (par. 211).
				X	(19) *Battery.* Check for proper charge and electrolyte level (par. 127).
			X	------	Remove battery and store in a warm place if vehicle is not equipped with a power plant heater.
X	------	------	X	X	(20) *Clean.* Clean snow, ice, and mud from all parts of vehicle.
X	------	------	------	------	(21) *Brakes.* Check for frozen brake shoes.

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle—Continued

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At-the-halt	After operation		
					UNUSUAL CONDITIONS—Continued *EXTREME COLD*—Continued
	X				(22) *Operating observations.* Check for the feel of stiffness of lubricant in the axles and power train units. This will be indicated by unusual power demand when placing vehicle in motion. Listen for signs of malfunctions and inspect immediately to determine cause.
					(23) *Winterization equipment.*
X				X	(*a*) Check personnel heater for proper operation.
			X		(*b*) Fill power plant heater fuel tank.
			X	X	(*c*) Check all winterization equipment for secure installation and proper functioning.
					EXTREME HEAT (par. 223)
X		X		X	(24) *Cooling and fuel systems.* Check carburetor air cleaner, engine oil filter, and radiator fins and clean as often as necessary to keep them in good condition.
X				X	(25) *Battery.* Check electrolyte level (par. 127).
				X	(*a*) Check for proper charge (par. 127).
			X		(*b*) Remove battery (par. 127) and store in a cool place if necessary to park for extended period.
		X	X		(26) *Tires.* Shield tires, if possible, from direct rays of the sun.
X				X	Check for proper presure (par. 211).
					UNUSUAL TERRAIN (par. 225)
			X		(27) *Lubrication.* Check for fouled lubricants and lubricate as necessary (par. 53).
X				X	(28) *Tires.* Check for proper pressure (par. 211).

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle—Continued

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At-the-halt	After operation		
					UNUSUAL CONDITIONS—Continued *UNUSUAL TERRAIN*—Continued
X	----	----	----	X	(29) *Cooling and fuel systems.* Check carburetor air cleaner, engine oil filter, and radiator fins and clean as often as necessary to keep them in good condition. ***Caution:***—Under extremely dusty condition or blowing sand it will be necessary to service the carburetor air cleaner several times daily during operation to prevent entry of dust or sand into the engine. Failure to do this may wear out engine parts in a short time.
X	----	X	----	X	(30) *Clean.* Clean all parts of the vehicle of snow, ice, mud, or sand.
				X	Check for any sandblasted surfaces and touch-up paint as required.
X	----	----	X	----	(31) *Vents.* Chech engine vents and other exposed vents and keep them covered with cloth to prevent entry of dust, sand, or drifting snow.
					FORDING OPERATIONS (par. 224)
X	----	----	----	----	(32) *Fording limits.* Check vehicle fording limits (par. 6). Loosen drive belts if required (par. 124). See paragraph 48, for operating instructions.
X	----	----	X	----	(33) *Tires.* Check for proper pressure (par. 211).
X	----	----	----	X	Check for availability and serviceability of tire chains. Install if necessary.
X	----	----	----	----	(34) *Battery.* Check vent for tightness to prevent entrance of water.
			X	----	Check for seepage of water into battery. Check charge as soon as practicable and add electrolyte and charge if necessary. (par. 127)
			X	----	(35) *Clean.* Remove water and sludge from all parts of the vehicle. If fording through salt water, wash vehicle off with fresh water.

Table II.—Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Vehicle—Continued

Intervals					Procedure
Operator's				Leader's "A" weekly)	
Before operation	During operation	At-the-halt	After operation		
					UNUSUAL CONDITIONS—Continued *FORDING OPERATIONS*—Continued
			X	------	(36) *Engine and transmission.* Check for evidence of water or grit and replace oil if necessary. If engine oil must be replaced, flush engine before adding new oil.
			X	------	(37) *Cooling and fuel system.* Clean carburetor air cleaner and engine oil filter; clean and replace if necessary.
			X	------	(38) *Lubrication.* Lubricate as specified on the lubrication chart (par. 53).
			X	------	(39) *Brake system.* Check for proper operation (par. 41).

63. Preventive Maintenance By Organizational Maintenance Mechanics

a. Intervals. The indicated frequency of the prescribed preventive maintenance services is considered a minimum requirement for normal operation of vehicle. Under unusual operating conditions, such as extreme temperatures, dust or sand, or extremely wet terrain, it may be necessary to perform certain maintenance services more frequently.

b. Driver or Operator Participation. The driver or operator should accompany vehicle and assist the mechanics while periodic organizational preventive maintenance services are performed. Ordinarily, the driver should present the vehicle for a scheduled preventive maintenance service in a reasonably clean condition.

c. Special Services. These are indicated by the item numbers in the columns which show the interval at which the services are to be performed, and show that the parts or assemblies are to receive certain mandatory services. For example, an item number in one or both columns opposite a *Tighten* procedure means that the actual tightening of the object must be performed. The special services are as follows:

(1) *Adjust.* Make all necessary adjustments in accordance with instructions contained in the pertinent section of this manual, information contained in changes to the subject publication, or technical bulletins.

(2) *Clean.* Clean the unit (par. 61) to remove old lubricant, dirt, and other foreign material.

(3) *Special lubrication.* This applies either to lubrication operations that do not appear on the vehicle lubrication chart (par. 53) or to items that do not appear but which should be performed in connection with the maintenance operations if parts have to be disassembled for inspection or service.

(4) *Serve.* This usually consists of performing special operations, such as replenishing battery water, draining and refilling units with oil, and changing or cleaning the engine oil filter, air cleaner, or cartridges.

(5) *Tighten.* All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the unit according to good mechanical practice. Use a torque-indicating wrench where specified. Do not overtighten, as this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lock washer, lock nuts, locking wire, or cotter pins to secure the tightened nut.

d. Special Conditions. When conditions make it difficult to perform the complete preventive maintenance procedures at one time, they can sometimes be handled in sections. Plan to complete all operations within the week if possible. All available time at halts and in bivouac areas must be utilized, if necessary, to assure that maintenance operations are completed. When limited by the tactical situation, items with special services in the columns should be given first consideration.

e. DA Form 461. The numbers of the preventive maintenance procedures that follow are identical with those outlined in DA Form 461. Certain items on the form that do not apply to this vehicle are not included in the procedures in this manual. In general, the sequence of items on the form is followed, but in some instances there is deviation for conservation of the mechanic's time and effort.

f. Procedures. Table III lists the services to be performed by the organizational mechanic or maintenance crew at the designated intervals. Each page of the table has two columns at its left edge corresponding to commander's "B" (1,000 miles or 60 days) and commander's "C" (6,000 miles or 6 months). Very often it will be found that a particular procedure does not apply to both scheduled intervals. In order to determine which procedure to follow, look down the column corresponding to the maintenance procedure and wherever an item number appears perform the operations indicated opposite the number.

Table III.—Commander's "B" and "C" preventive maintenance services

Intervals		
Commander's "B" (1,000 miles or 60 days)	Commander's "C" (6,000 miles or 6 months)	Procedure
		INSPECTION AND ROAD TEST
		BEFORE OPERATION: *Fuel, oil, water, antifreeze, tires, instruments, leaks, general visual inspection of vehicle and equipment.* Perform the *before-operation* service (par. 62).
1	1	*Dash instruments, switches, and gages, oil pressure, ammeter, speedometer, temperature, fuel, ignition switch, and other controls.* Note generator output on ammeter immediately after starting the engine, before generator has reduced the charging rate. Observe all instruments for normal readings. Notice if ignition switch operates freely and makes positive contact, and check all other controls for normal operation.
2	2	*Horns, mirrors, and windshield wipers.* Sound horn to see if signal is normal (if tactical situation permits). Test windshield wipers for satisfactory operation. Examine mirrors and reflectors.
3	3	*Engine—idle, acceleration, power, noise.* In warming up the engine, observe if it starts easily and if action of choke control and throttle control are satisfactory. Notice if idling speed is correct. Listen for any unusual noises at idle and higher speeds. When operating the vehicle, notice if it has normal power and acceleration in each speed. Listen for any unusual noises when the engine is under load.
4	4	*Steering—free play, bind, wander, shimmy, side pull, column and wheel.* With the vehicle moving straight ahead, see if the steering wheel has excessive free play and if there is any tendency to wander, shimmy, or pull to the side. Turn the steering wheel through its entire range and note any bind. Examine steering column and wheel.
5	5	*Clutch—free travel, drag, noise, chatter, grab, slip.* See if clutch pedal has specified free travel and if action of pedal return spring is satisfactory. Note whether clutch disengages completely or has a tendency to drag. Observe smoothness of engagement and tendency to chatter, grab, or slip and any unusual noise. With transmission in neutral, depress and release clutch pedal, listening for defective release bearing.

Table III.—Commander's "B" and "C" preventive maintenance services—Con.

Intervals		Procedure
Commander's "B" (1,000 miles or 60 days)	Commander's "C" (6,000 miles or 6 months)	
		INSPECTION AND ROAD TEST—Continued
7	7	*Brakes—(service and parking)—braking effect, feel, side pull, noise, chatter, pedal travel, and hand control.* See if brake pedal has specified free travel and if action of return spring is satisfactory. Observe if pedal goes too close to floor. Make several stops noting side pull, noise, chatter, or any other unusual conditions. Observe if ratchet or parking brake control handle holds and if the handle requires more than three-quarters travel for full application. Stop the vehicle on an incline and apply the parking brake to see if it holds the vehicle or if application of the parking brake at a speed of 10 mph stops the vehicle within a reasonable distance.
8	8	*Generator, starter, and switch—action, noise, speed.* Notice if the starter switch pedal requires only normal pressure, and if the starter engine engages smoothly without unusual noise and turns the engine with adequate cranking speed.
9	9	*Transmission and transfer—lever action, decluthing, vibration, noise.* Shift transmission and transfer into all speeds, observing any unusual stiffness of the shift levers, tendency to slip out of speed, unusual noise, or excessive vibration. Make similar observations with transfer front wheel drive shift lever.
10	10	*Unusual noises—attachments, body, wheels, power train.* At all times during the road-test, be alert for unusual or excessive noises that might indicate looseness, defects, or deficient lubrication in these components.
11	11	*Lamps—tail, body, running, stop, and blackout.* During stops in the road-test, test the operation of these exterior and interior lights and light switches. Notice if headlights appear to be properly aimed. Note condition of lights and safety reflectors.

Table III.—Commander's "B" and "C" preventive maintenance services—Con.

Intervals		Procedure
Commander's "B" (1,000 miles or 60 days)	Commander's "C" (6,000 miles or 6 months)	
		AFTER ROAD TEST
25	25	*Temperatures—brake drums, hubs, axles, transmission, transfer, differentials.* Immediately after the road-test, feel these units cautiously. An overheated wheel hub and brake drum indicates an improperly adjusted, defective, or dry wheel bearing or a dragging brake shoe. An abnormally cool condition indicates an inoperative brake. An overheated gear case indicates internal maladjustment, damage, or lack of lubrication. *Note.*—It is normal for hypoid rear axles to run quite hot after the vehicle has run a considerable distance. If these particular units are too hot for the hand to be placed upon them, it is not necessarily a sign of malfunctioning. If they are adequately lubricated and did not howl during the road-test, assume that they are all right.
25	----------	*Inspect propeller shafts.* Tighten universal joint assemblies and flange nuts.
26	26	*Leaks.—engine oil, fuel, water, axles, housings, transmission, transfer, and all other components carrying fluid, oil, or grease.* Make general observations in the engine compartment and underneath the vehicle for oil, water, fuel, and exhaust leaks. Look at spark plug, exhaust manifold, and cylinder-head gaskets. **Caution.**—Do not tighten the cylinder head or manifold unless there is evidence of looseness or leakage. If cylinder head requires tightening, use a torque-indicating wrench (par. 91) and tighten in proper sequencee (fig. 28).
27	27	*Lubrication—lubricate vehicle in accordance with lubrication chart* (par. 53). Inspect vehicle for proper lubrication. Coordinate with inspection and disassembly operations to avoid duplication.
27	27	During lubrication inspect tires for unusual wear, penetrating objects, and proper matching.
27	----------	Rotate and match tires according to tread design and degree of wear (par. 211). See TM 31–200 for acceptable limits in matching tires. Tighten axle flange nuts.
28	28	*Battery—specific gravity.* Make hydrometer test of electrolyte in each cell (par. 127) and record specific gravity in space provided on DA Form 461.
29	29	*Battery—voltage.* Perform a high rate discharge test according to instructions in paragraph 127 or instructions accompanying the test instruments. Record voltage of each cell in space provided on DA Form 461.

Table III.—Commander's "B" and "C" preventive maintenance services—Con.

Intervals		
Commander's "B" (1,000 miles or 60 days)	Commander's "C" (6,000 miles or 6 months)	Procedure
		AFTER ROAD TEST—Continued
29	....	After battery test, clean top of battery (par. 127), coat terminals lightly with grease, repaint carrier if corroded. Look to see if battery requires water (par. 127). *Note.*—If distilled or approved water is not available, clean water, preferably rain water, may be used.
30	....	*Compression.* Test compression in each cylinder (par. 86), with throttle and choke wide open, and record in space provided on DA Form 461. It is preferable to make compression test with engine at operating temperature.
31	31	*Breather caps and ventilators.* Inspect carburetor- and crankcase-ventilator caps and carburetor air cleaner.
31	....	Clean and service above items in accordance with the lubrication chart (par. 53), or instructions in the pertinent section of this manual.
32	....	*Radiator—core, shell, hoses, cap, and gasket.* Inspect these items, noticing particularly if the radiator core is clogged with foreign matter or if fins are bent. Test the operation of the pressure cap. Observe coolant level (par. 121) and examine coolant for contamination. In cold weather, test coolant with a hydrometer to see if it contains sufficient antifreeze.
32	....	If need is indicated, drain radiator and cylinder block (par. 121) clean, flush (par. 121), refill (par. 121) and add inhibitor (par. 121), unless antifreeze, which contains inhibitor, is used. Tighten radiator mountings and hose clamps.
33	33	*Water pump— fan, drive belts, and pulleys.* Inspect pulleys and fan for alinement and drive belts for proper tension (par. 124). Notice if water pump is leaking.
34	....	*Intake and exhaust valve mechanism—clearance, cover gaskets.* Gage intake and exhaust valve-tappet clearance (par. 92*a* and *b*) and look for broken or weak valve springs if need is indicated by engine performance, low compression, or tappet noise. If clearance is found insufficient, adjust (par. 92*a* and *b*) and check engine compression (par. 86). Inspect cover gaskets.

Table III.—Commander's "B" and "C" preventive maintenance services—Con.

Intervals		Procedure
Commander's "B" (1,000 miles or 60 days)	Commander's "C" (6,000 miles or 6 months)	
		AFTER ROAD TEST—Continued
35	----------	*Spark plugs—clean and adjust, distributor, cap, rotor, points, shaft, advance unit, coil and wiring, ignition timing.* Remove and inspect spark plugs (par 114). Inspect distributor cap, rotor, and breaker points and test operation of centrifugal and vacuum advance mechanism by hand. Test distributor shaft for looseness by hand feel. Test ignition coil and distributor capacitor with high-tension ignition circuit tester, if available, according to instructions accompanying the test instrument. Using neon timing light, observe if ignition timing is correct (par. 112) and if spark advances automatically as engine is accelerated. Test generator regulator with a low-voltage circuit following instructions accompanying the test instrument.
35	----------	Clean spark plugs and adjust point gap (par. 114). Dress distributor breaker points and adjust point gap (par. 113). If points are badly pitted, replace both points and capacitor.
37	37	*Carburetor, choke, throttle, linkage, and lines.* Inspect these items, noticing particularly if the shafts and linkage operate freely and are not excessively worn. Observe if the choke valve opens fully when the choke control is released and if the throttle valve opens fully when the accelerator is fully depressed.
37	----------	Make an engine vacuum test (par. 86), and adjust carburetor idle mixture (par. 102). Test fuel pump pressure (par. 66).
37	----------	Examine fuel lines and connections for evidence of leaks.
38	----------	*Exhaust pipe and muffler.* Inspect; listen for excessive or unusual noises and look for exhaust leaks.
38	----------	Tighten mountings.
39	----------	*Brake shoes—linings, links, guides, anchors, supports, cylinders, hose, and lines.* Inspect flexible brake lines and solid lines and test brake linkage for freedom of action. Remove wheels and hubs (par. 209) and examine brake drums, shoes, linings, guides, anchors, supports, retractor springs, and cylinders.

Table III.—Commander's "B" and "C" preventive maintenance services—Con.

Intervals		Procedure
Commander's "B" (1,000 miles or 60 days)	Commander's "C" (6,000 miles or 6 months)	
		AFTER ROAD TEST—Continued
39	----------	Wheel bearings will be disassembled (pars. 174 and 183), cleaned and repacked (par. 174) in *every second* 6,000 mile inspection or *annually*. If the wheel bearings are due for repacking, remove wheels and hubs (pars. 174 and 185) and make observations for the brake internal components as in the preceding paragraph. Adjust service brakes (par. 191*a*). If wheels have not been disassembled from brake drums, tighten wheel nuts.
40	----------	*Body—hardware, glass, top and frame, curtains and fasteners, seats, upholstery, trim, safety straps, and paint.* Inspect these items, paying particular attention to body mountings and springs. Test operation of windshield, hood hinges, and fasteners. Observe seat mountings and upholstery. Make a general inspection of the body including glass, panels, tops, fenders, running boards, chains, bows, paulins, curtains, and grille. Examine condition of paint and legibility of markings and inedtification and caution plates.
40	----------	Tighten body mounting bolts. Loosen the steering column clamp before tightening body mounting bolts and tighten afterwards. Tighten spring clips and rebound clips.
42	----------	*Bumpers—fromt and rear and pintle hook.* Inspect these items including tow hooks. Test operation of pintle hook.
		FINAL ROAD TEST
		Perform the final road test as outlined under ROAD TEST at the beginning of this table. Pay special attention to any items which may have been repaired or adjusted.
		UNUSUAL CONDITIONS
		Maintenance operations and road test as prescribed under usual conditions will apply equally well under unusual conditions for operations for all occasions except in extreme-cold weather. Intervals are necessarily shortened in extreme-cold weather servicing and maintenance. Vehicles subjected to salt-water immersion or complete submersion are evacuated to ordnance maintenance unit as soon as possible after exposure (par. 224).

Section IV. TROUBLE SHOOTING

64. Scope

a. This section contains trouble shooting information and tests for locating and correcting most troubles which may develop in the vehicle. Trouble shooting is a systematic isolation of defective components by means of an analysis of vehicle trouble symptoms; testing to determine the defective component and applying the remedies. Each symptom of trouble given for an individual unit or system is followed by a list of probable causes of the trouble and suggested procedures to be followed.

b. This manual cannot cover all possible troubles and deficiencies that may occur under the many conditions of operation. If a specific trouble, test, and remedy therefor are not covered herein, proceed to isolate the system in which the trouble occurs and then locate the defective component. Do not neglect use of any test instruments such as voltmeter, ammeter, test lamp, hydrometer, and pressure and vacuum gages that are available. Standard automotive theories and principles of operation apply in trouble shooting the vehicle. Question vehicle driver or operator to obtain maximum number of observed symptoms. The greater the number of troubles that can be evaluated, the easier will be the isolation of the defect.

65. Engine

a. *Engine Will Not Turn.*

(1) *Weak or discharged batteries.* Test batteries and replace (par. 127) if necessary.

(2) *Incorrect oil viscosity.* Inspect engine oil. If improper grade, drain and refill with correct grade (par. 53) of engine oil.

(3) *Starter inoperative.* Refer to paragraph 69.

(4) *Mechanical seizure of engine parts.* Notify ordnance maintenance personnel.

b. *Engine Turns but Will Not Start.*

(1) *Insufficient fuel.* Check fuel gage (fig. 6) on instrument panel with ignition switch turned on, and also check actual level in fuel tank to be sure there is sufficient fuel for operation and that fuel gage is operative.

(2) *Loose or corroded battery or ground cable connection.* Clean and tighten all connections in the starting system circuit (fig. 64).

(3) *Faulty ignition system.* Remove one of the spark plug cables (fig. 57) and hold end of cable one-quarter of an inch

from cylinder head while cranking the starter. If a spark does not jump the gap between the end of the cable and the cylinder head, the ignition system is inoperative. Refer to paragraph 68.

(4) *Insufficient cranking speed.* Refer to paragraph 69.

(5) *Faulty fuel system.* Remove the fuel inlet line from the carburetor and, with the ignition switch off, crank the engine with the starter. If a free flow of fuel is not evident from the end of the fuel line, fuel is not reaching the carburetor. Refer to paragraph 66.

(6) *Carburetor choke inoperative.* Remove air intake hose and inspect for a restriction. Inspect choke controls for proper operation. Adjust choke if necessary (par. 102).

(7) *Sticking valves.* Remove valve covers and apply penetrating oil or kerosene to valve stems. If valves are still not free, notify ordnance maintenance personnel.

(8) *Improper valve adjustment.* Check valve clearances and adjust valves (par. 92*a*) as necessary.

c. Engine Does Not Develop Full Power.

(1) *Improper grade of fuel.* Use fuel having an octane rating of 68 to 72.

(2) *Faulty ignition system.* Refer to *b*(3) above.

(3) *Oil temperature too high.* Improper grade of engine oil or insufficient oil level may cause excessive oil temperatures. Drain and refill with specified engine oil (par. 53).

(4) *Improper valve adjustment.* Check valve clearances and adjust as necessary (par. 92*a*).

(5) *Sticking valves.* Remove valve covers and apply penetrating oil or kerosene to valve stems. If valves are still not free, notify ordnance maintenance personnel.

(6) *Improperly adjusted carburetor.* Adjust carburetor (par. 102) paying particular attention to the choke adjustment.

(7) *Clogged muffler or bent exhaust pipe or tail pipe.* Replace muffler or exhaust pipe (pars. 109 and 110).

(8) *Preignition.* With engine temperature at normal operating range (160° to 180° F.), rapidly accelerate vehicle in high gear. If preignition or spark knock is present, a pinging sound will be heard during at least a portion of the accelerating period. The intensity of the pinging can be increased by covering the radiator and causing the engine to operate at excessively high temperatures. Check ignition timing (par. 112) and adjust, if necessary, as late ignition timing is often a cause of preignition. If correct grade of fuel is being used and the ignition system is found to be functioning

satisfactorily, the spark plugs may be of improper heat range or faulty. Replace the spark plugs (par. 114). If spark plug replacement or resetting of ignition timing does not correct the condition, notify ordnance maintenance personnel.

(9) *Low or uneven engine compression.* Make a compression test (par. 86). If compression registers low or has 10 psi variation between cylinders, notify ordnance maintenance personnel.

(10) *Restricted carburetor air cleaner.* Service or replace carburetor air cleaner (par. 107).

(11) *Partially clogged fuel lines.* Disconnect fuel lines at units and blow out with compressed air. If fuel line is kinked or bent to a point where fuel flow may be affected, replace the fuel line.

(12) *Late ignition timing.* Check ignition timing and adjust as necessary (par. 112).

(13) *Brakes dragging.* Adjust brakes (par. 191*a*).

(14) *Incorrect valve timing.* Notify ordnance maintenance personnel.

(15) *Engine overheated.* Refer to paragraph 65*f*.

d. Engine Misfires at Idling Speed.

(1) *Faulty ignition system.* Refer to *b*(3) above.

(2) *Low or uneven engine compression.* Refer to *c*(9) above.

(3) *Faulty spark plugs.* Test each spark plug by individually shorting it out. Stop engine and disconnect spark plug cable. Start engine and hold end of spark plug cable against cylinder head. If a noticeable difference in engine performance results, spark plug is operating. If no difference is noted, replace spark plug (par. 114). Test each spark plug in this manner.

(4) *Leaking valves.* Check engine vacuum with a vacuum gage (par. 86). Erratic readings at constant engine speed are indication of leaking valves or faulty valve operation. Notify ordnance maintenance personnel. Also covers may be removed (par. 91) and an examination of the valve mechanism made. If any broken valve springs or damaged valves or intake push rods are noticed, notify ordnance maintenance personnel.

(5) *Leak at carburetor gasket.* Apply a coating of oil around edge of gasket between carburetor and cylinder head. Crank engine with starter. A sucking sound will be heard if the gasket leaks. Replace carburetor gasket (par. 102).

(6) *Leaking cylinder head gasket.* Examine cylinder block and cylinder head for evidence of carbon streaks. Tighten cylinder head nuts in proper sequence (fig. 28) to 65 to 70 pound-feet torque. If leak persists, replace cylinder head gasket (par. 91).

(7) *Carburetor improperly adjusted or faulty.* Adjust carburetor (par. 102). If condition is not improved, replace carburetor (par. 102).

e. Engine Misfires at High Speed.

(1) *Faulty ignition system.* Refer to paragraph 68.

(2) *Incorrect valve adjustment.* Check valve clearances and adjust as necessary (par. 92).

(3) *Faulty valves.* Refer to *d*(4) above.

(4) *Leaking cylinder head gasket.* Proceed as in *d*(6) above.

(5) *Faulty fuel pump.* Test fuel pump pressure (par. 66). Replace fuel pump if necessary (par. 104).

(6) *Carburetor improperly adjusted or faulty.* Adjust carburetor (par. 102). If condition is not improved, replace carburetor (par. 102).

(7) *Incorrect engine timing.* Adjust engine timing (par. 112).

f. Engine Overheats.

(1) *Inoperative cooling system.* Refer to paragraph 71.

(2) *Late ignition timing.* Check ignition timing and adjust as necessary (par. 112).

(3) *Incorrect carburetor adjustment.* Check and adjust carburetor (par. 102).

(4) *Incorrect engine oil viscosity or low engine oil level.* Drain and refill with fresh engine oil of correct grade (par. 53).

(5) *Inoperative thermostat.* Replace inoperative or faulty thermostat (par. 125).

(6) *Drive belts loose or broken.* Adjust or replace drive belts (par. 124).

(7) *Clogged muffler or kinked exhaust or tail pipe.* Replace muffler (par. 109) or exhaust pipe (par. 110).

(8) *Improper valve timing.* Notify ordnance maintenance personnel.

(9) *Excessive carbon condition in engine.* Notify ordnance maintenance personnel.

(10) *Insufficient oil circulation.* Notify ordnance maintenance personnel.

g. Excessive Oil Consumption.

(1) *Engine overheats.* Refer to *f* above.

(2) *Leaks.* Inspect engine, engine compartment, and ground under engine for indications of engine oil leakage. Tighten

any leaking connections, repair or replace broken oil lines, or notify ordnance maintenance personnel.

(3) *Poor engine compression.* Refer to *c*(9) above.

(4) *Engine oil level too high.* Maintain oil at correct level.

(5) *Improper grade and viscosity of engine oil.* Drain and refill crankcase with correct grade engine oil (par. 53).

(6) *Excessive high speeds.* Avoid unnecessary and excessive speeds.

(7) *Excessive low-gear driving.* Operate vehicle in proper gear for desired speed and terrain (par. 41).

(8) *Piston rings stuck in grooves of piston.* Notify ordnance maintenance personnel.

(9) *Clogged oil return holes in piston rings.* Notify ordnance maintenance personnel.

(10) *Excessive connecting rod and main bearing clearance.* Notify ordnance maintenance personnel.

(11) *Excessive intake valve guide clearance.* Notify ordnance maintenance personnel.

(12) *Loose or worn pistons.* Notify ordnance maintenance personnel.

56. Fuel and Air Intake System

a. Fuel Does Not Reach Carburetor.

(1) *Lack of fuel.* Check fuel gage (fig. 6) on instrument panel with ignition switch turned on, and also check actual level in fuel tank to be sure there is sufficient fuel for operation and that fuel gage is operative.

(2) *In operative fuel pump.* Disconnect fuel line from inlet side of carburetor. Crank engine with starter. If a free flow of fuel is not evident from the fuel line, check fuel pump (*b*(2) below). If fuel pump is faulty, replace fuel pump (par. 104).

(3) *Clogged fuel line.* Disconnect fuel line from fuel tank and fuel pump. Blow fuel line out with compressed air.

b. Fuel Does Not Reach Cylinders.

(1) *Faulty carburetor.* Perform test in *a*(2) above. If a free flow of fuel is evident and fuel lines are clear, carburetor is faulty or jets are clogged. Replace carburetor (par. 102).

(2) *Low fuel-pump pressure.* Disconnect outlet fuel line from fuel pump and install pressure gage on outlet side of fuel pump (fig. 19). Crank engine with starter. Fuel pump pressure should be between 4 and 5 psi. If pressure is less than 4 psi, refer to *f* below.

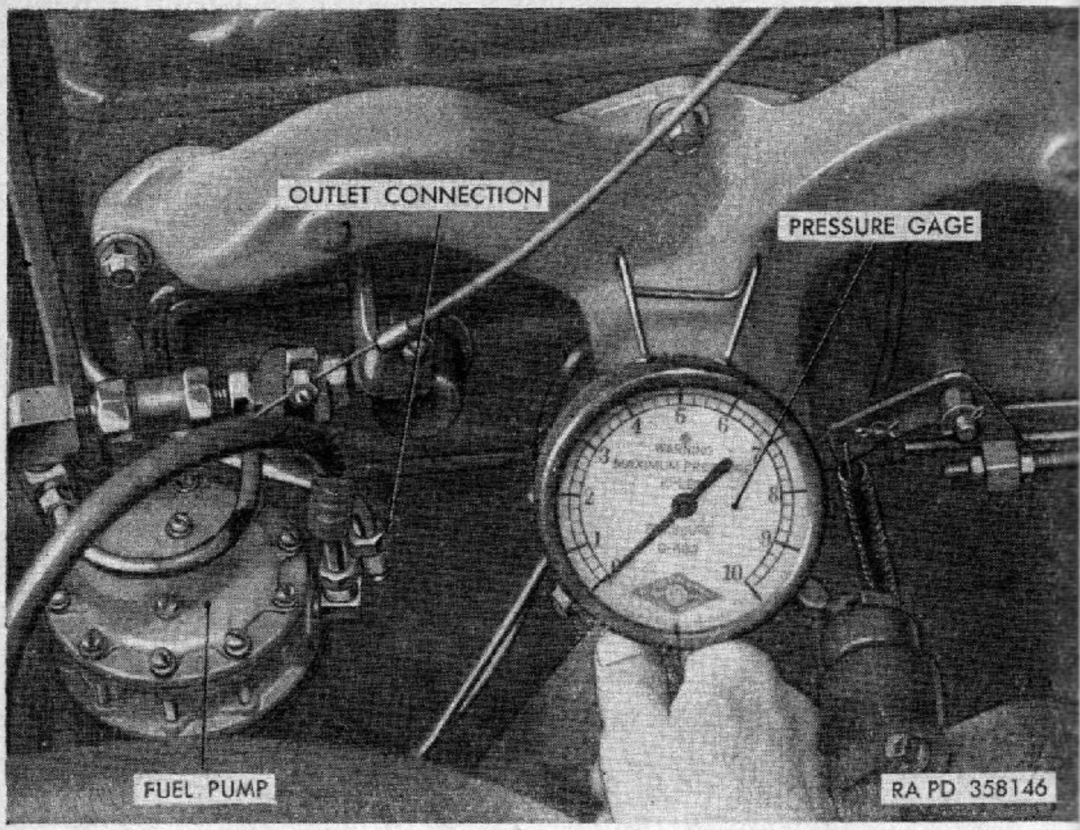


Figure 19. Testing fuel pump pressure.

(3) *Clogged fuel tank vent line.* Disconnect and blow out fuel tank vent line with compressed air.

c. Excessive Fuel Consumption.

(1) *Fuel leaks.* Examine all components of the fuel system (fig. 44) for leaks. Tighten or replace faulty components as required.

(2) *Carburetor float level to high.* Replace carburetor (par. 102).

(3) *Worn carburetor parts.* Replace carburetor (par. 102).

(4) *Worn engine parts.* Refer to paragraph 86 for engine vacuum and compression tests. Notify ordnance maintenance personnel if engine parts are worn.

(5) *Improper spark plug gap.* Adjust spark plug gap (par. 114).

(6) *Worn distributor breaker points.* Adjust or replace (par. 113), distributor breaker points if condition warrants.

(7) *Leaking fuel pump diaphragm.* Replace fuel pump (par. 104).

(8) *Valves sticking.* Refer to paragraph 65*b*(7).

(9) *Weak ignition coil or capacitor.* Replace ignition coil (par. 113) or capacitor (par. 113).

(10) *Carburetor air cleaner clogged.* Service or replace carburetor air cleaner or element (par. 107).

(11) *Improper choke adjustment.* Adjust choke (par. 102).

d. Engine Stops When Idling.

(1) *Engine cold.* Pull out throttle control (fig. 6) until engine reaches proper operating temperature (160° to 180° F).

(2) *Improper carburetor adjustment.* Adjust carburetor (par. 102).

(3) *Sticking or bent choke linkage.* Free up, adjust, and repair choke lingage (par. 102).

(4) *Improper ignition timing.* Refer to paragraph 112.

(5) *Leak at carburetor gaskets.* Refer to (6) below.

(6) *Faulty carburetor.* Replace carburetor (par. 102).

e. Engine Idles Too Fast.

(1) *Improper carburetor adjustment.* Adjust carburetor (par. 102).

(2) *Improper carburetor linkage adjustment.* Adjust carburetor linkage (par. 102).

(3) *Faulty carburetor (idle adjustment screw damaged).* Replace carburetor (par. 102).

f. Low Fuel Pump Pressure.

(1) *Clogged fuel lines.* Disconnect fuel lines at fuel tank, fuel pump, and carburetor and blow out with compressed air.

(2) *Air leaks at fuel line connections.* Examine all fuel lines and connections for leaks and repair or replace as necessary.

(3) *Faulty fuel pump.* Replace fuel pump (par. 104).

g. Engine Falters on Acceleration.

(1) *Binding or sticking carburetor linkage.* Free up and adjust carburetor linkage (par. 102).

(2) *Clogged or worn carburetor parts.* Replace carburetor (par. 102).

(3) *Low fuel pump pressure.* Refer to *f* above.

67. Exhaust System

a. Excessive Noise.

(1) *Broken or split muffler or muffler connections.* Examine muffler and connections and if found defective replace (par. 109).

(2) *Leaking exhaust manifold gasket.* This will be evidenced by carbon streaks on cylinder block or by rush of exhaust gases against hand. Replace exhaust manifold gasket (par. 88).

(3) *Broken, split, or pinched exhaust pipe or exhaust pipe extension.* Replace exhaust pipe or exhaust pipe extension (par. 110).

(4) *Leaking exhaust pipe connections.* Replace defective parts ((3) above).

b. Odor of exhaust Fumes in Driver's Compartment. Leak somewhere in exhaust system (fig. 55). Replace defective parts as necessary.

Caution.—Replace defective exhaust system parts as soon as possible as exhaust gas (carbon monoxide) is poisonous.

68. Ignition System

a. No Spark (Ammeter Registers Zero When Ignition Switch Is Turned On).

(1) *Low or faulty batteries.* Test batteries (par. 127) and if excessively low, charge or replace (par. 127).

(2) *Loose or disconnected battery cables.* Clean and connect battery cables.

(3) *Faulty ignition switch.* Replace ignition switch if found to be at fault (par. 144).

(4) *Faulty ammeter.* Replace ammeter if found to be at fault (par. 137).

(5) *Broken primary circuit from ignition switch to ignition coil or from ignition coil to distributor.* An ammeter reading zero while ignition switch (fig. 56) is turned on and engine is being cranked indicates that no current is flowing in the primary circuit.

(*a*) Disconnect cable at battery side of ammeter and make flash test to determine if current is flowing to ammeter. If no flash is noticed, check connections and cable.

(*b*) Check continuity of circuit from ammeter to ignition switch and through ignition switch, with ignition switch turned off.

(*c*) Check continuity of circuit through primary cable from ignition switch to ignition coil and from ignition coil to distributor. If current flows through primary cable from ignition switch to ignition coil but not from ignition coil to distributor, replace ignition coil (par. 113). If current flows through primary cable and ignition coil to the distributor, the trouble lies within the distributor.

(*d*) Inspect distributor cap, rotor, breaker points, and housing. Replace faulty parts or distributor and ignition coil assembly (par. 113).

b. No Spark (Ammeter Shows Normal Reading When Ignition Switch Is Turned On). If ammeter shows normal discharge with ignition switch turned on (2 to 4 amps), the primary circuit is functioning correctly and the trouble is in the secondary circuit.

(1) *Faulty distributor cap.* Remove distributor cap (par. 113) and inspect for cracks or carbonized paths indicating current leaks. Inspect all carbon tips in distributor cap. Replace distributor cap if any carbon tips are worn or broken.

(2) *Faulty distributor rotor.* Replace distributor rotor (par. 113).

(3) *Faulty spark plug cables.* Test each spark plug cable by disconnecting from spark plug (par. 114) and holding one-quarter of an inch from cylinder head while cranking engine with starter. Replace any spark plug cable not producing a good spark (par. 114).

(4) *Breaker points faulty or not opening.* Remove ignition coil and distributor cap and inspect breaker points for burned or pitted contact surfaces. Replace breaker points (par. 113) if surfaces are not satisfactory. If breaker points appear to be in good condition, check gap opening (par. 113).

(5) *Faulty capacitor.* If a capacitor tester is available, check capacity of capacitor. Reading should be 25 to 26 mfd ± 10 percent. Replace capacitor (par. 113) if reading is not within these limits. If no capacitor tester is available, check capacitor by substitution.

(6) *Open secondary winding in ignition coil.* If steps above have been completed and ignition coil was not replaced, test for spark by disconnecting a spark plug cable from one spark plug. Hold cable terminal about one-quarter of an inch from cylinder head and crank engine with starter. If no spark is observed, replace ignition coil (par. 113).

c. Weak spark.

(1) *Faulty ignition coil.* Replace ignition coil (par. 113).

(2) *Loose electrical connections.* Clean and tighten all connections from starter to distributor and ignition coil assembly.

(3) *Faulty distributor cap.* Refer to *b*(1) above.

(4) *Faulty capacitor.* Replace capacitor (par. 113).

(5) *Faulty distributor breaker points.* Adjust breaker point opening (par. 113) or replace breaker points if burned or pitted (par. 113).

d. Engine backfires.

(1) *Cracked distributor cap.* Refer to *b*(1) above.

(2) *Crossed spark plug cables.* Check cables to be sure they are connected in proper sequence (par. 114).

e. Engine Misfires at High Speed Under Load.

(1) *Distributor breaker point gap incorrect.* Adjust distributor breaker points (par. 113).

(2) *Faulty capacitor.* Replace capacitor (par. 113).

(3) *Faulty ignition coil.* Replace ignition coil (par. 113).

(4) *Incorrect spark plug gap.* Adjust spark plug gap (par. 114) or replace spark plugs if necessary.

69. Starting System

a. Starter Fails To Operate.

(1) *Weak or discharged batteries.* Check batteries water level and specific gravity (par. 127) and clean and tighten battery terminals. Charge or replace batteries as required (par. 127).

(2) *Loose battery ground cable.* Clean and tighten battery ground cable (fig. 69).

(3) *Faulty starter switch.* Using a heavy cable, short the two terminal posts on the starter switch (fig. 66). If starter operates satisfactory, starter switch is faulty. Replace starter (par. 116).

(4) *Faulty starter.* If the above operations have been completed and the starter still does not operate, the starter is at fault and should be replaced (par. 116).

(5) *Seized engine parts.* Notify ordnance maintenance personnel.

b. Noisy Starter Operation.

(1) *Loose starter mounting.* Tighten cap screws securing starter (fig. 66).

(2) *Lack of lubrication.* Replace starter (par. 116).

(3) *Worn starter commutator or bushings.* Replace starter (par. 116).

(4) *Faulty starter drive assembly.* Replace starter (par. 116).

c. Slow Cranking Speed.

(1) *Weak or discharged batteries.* Refer to *a*(1) above.

(2) *Loose battery ground cable.* Refer to *a*(2) above.

(3) *Improper grade engine oil.* Drain and refill engine crankcase with proper grade (par. 53) engine oil.

(4) *Sticking brushes, worn commutator, or armature rubbing field coils.* Replace starter (par. 116).

70. Generating System

a. Battery Not Being Charged.

(1) *Loose or corroded battery terminals.* Clean and tighten battery terminals.

(2) *Excessive resistance in cables.* Test cables for resistance or replace cables (par. 127).

Note.—Before assuming either the charging system or the associated charge indicator to be faulty, run the engine at a speed slightly above idle (apprx. 15 mph) for a period of about 15 minutes, and observe ammeter. The reason is that under certain severe battery discharge conditions, the battery will accept only a very slight charge when the engine is first run, the charging rate increasing during the 15 minutes run. This initial slight charge may be small enough so as not to be noticeable on the ammeter, and thus lead to the conclusion that the gage or the charge system is faulty.

(3) *Faulty generator regulator.* If there is low or no charging rate with low battery, replace generator regulator (par. 119).

(4) *Faulty ammeter.* Replace ammeter (par. 137).

(5) *Generator not charging.*

(*a*) *No generator output.* If there is no registered output from the generator, replace generator (par. 118).

(*b*) *Unsteady or low generator output.* Check for loose drive belts and adjust drive belts (par. 124) or replace generator (par. 118).

b. High Charging Rate With Fully Charged Batteries.

(1) *Corroded or loose cable connections.* Clean and tighten all cable connections in the generating system circuit (fig. 67).

(2) *Faulty generator regulator.* Replace generator regulator (par. 119).

c. Noisy Generator.

(1) *Lack of lubrication.* Lubricate generator (par. 53).

(2) *Loose generator mounting.* Tighten generator mounting bolts (fig. 68).

(3) *Excessively tight drive belts.* Adjust drive belts (par. 124).

(4) *Worn or faulty generator.* Replace generator (par. 118).

71. Cooling System

a. Cooling System Overheats.

(1) *Low coolant level.* Replenish water (par. 121). Add anti-freeze solution, if required.

(2) *Clogged cooling system.* Clean cooling system (par. 121).

(3) *Loose or worn drive belts.* Adjust or replace drive belts (par. 124).

(4) *Faulty thermostat.* Remove and test thermostat. Replace thermostat if faulty (par. 125).

(5) *Leaks in cooling system.* Inspect cooling system for leaks. paying particular attention to hoses, water pump, or radiator. If leaking, tighten loose hose connections or replace leaking water pump (par. 123) or radiator (par. 122).

(6) *Faulty water pump.* Replace water pump (par. 123).

(7) *Late ignition timing.* Refer to paragraph 65*f*.

(8) *Incorrect carburetor adjustment.* Check and adjust carburetor (par. 102).

(9) *Incorrect engine oil viscosity or low engine oil level.* Drain and refill with fresh engine oil of correct grade (par. 53).

(10) *Clogged muffler or kinked exhaust or tail pipe.* Replace muffler (par. 109) or exhaust pipe (par. 110).

(11) *Improper valve timing.* Notify ordnance maintenance per-maintenance personnel.

(12) *Excessive carbon condition within engine.* Notify ordnance tenance personnel.

(13) *Insufficient engine oil circulation.* Notify ordnance maintenance personnel.

b. Cooling System Remains Too Cool. If thermostat remains open, the cooling system will operate at too low a temperature in cold weather. Test thermostat and replace (par. 125) if necessary.

72. Battery and Lighting System

a. General. When checking or trouble shooting the battery and lighting system, refer to the vehicle wiring diagram (fig. 87) or the diagram for batteries and lighting system circuit (fig. 76). Most common source of light failures on the lighting system are due to either a discharged battery or grounded or shorted cables.

b. Discharged Batteries.

(1) *Operation of electrical units without generator operating (engine not running).* Whenever possible, avoid continued use of electrical equipment with the engine stopped.

(2) *Loose or corroded terminals.* Clean and tighten terminals.

(3) *Battery electrolyte level low.* Replenish battery water to one-half inch above top of plates (par. 127).

(4) *Excessive resistance in battery cables.* Check voltage drop across cables. If drop is greater than one-tenth volt replace battery cables (par. 127) if necessary.

(5) *Faulty generator regulator.* Replace generator regulator (par. 119).

(6) *Faulty generator.* Replace generator (par. 118).

c. No Vehicle Lights Burn.

(1) *Weak or discharged batteries.* Test battery specific gravity (par. 127) and charge or replace batteries as necessary (par. 127).

(2) *Faulty light switch.* Replace light switch (par. 145).

(3) *Faulty main feed cable.* Replace main feed cable.

(4) *Faulty generator regulator.* Replace generator regulator (par. 119).

(5) *Shorted or grounded cable in lighting system circuit (fig. 76) causing circuit breaker to continually operate.* Check all cables in the lighting circuit (fig. 76) and repair or replace faulty cable.

(6) *Corroded lamp contacts or broken lamp filament.* In extreme cases where the vehicle has been inactive for a long period, the lamp contacts may have become corroded. Clean lamp contacts or replace lamp or lamp units (pars. 128, 129, 130, and 131). In other cases where the vehicle has been subjected to hard bumps either during shipment or operation, the lamp filaments may have become broken or damaged. Replace lamp units or lamps (pars. 128, 129, 130, and 131).

d. One Light Fails To Light.

(1) *Poor ground connection.* Inspect ground cable or connection and tighten or replace ground cable.

(2) *Burned out lamp unit or lamp.* Replace burned out lamp unit or lamp (pars. 128, 129, 130, and 131).

(3) *Grounded or shorted feed cable between light switch and light.* Examine cable for grounded or shorted condition, frayed insulation, loose terminal, or broken cable. Repair, tighten, or replace cable as necessary.

(4) *Faulty light switch.* Replace light switch (par. 145).

e. Insufficient Light.

(1) *Dirty light lens.* Clean light lens.

(2) *Weak or discharged batteries.* Test battery specific gravity (par. 127) and charge or replace batteries as necessary (par. 127).

(3) *Poor ground connection.* Inspect ground cable or connection and replace or tighten ground cable as necessary.

(4) *Loose or corroded terminals.* Clean and tighten terminals.

(5) *Excessive resistance in lighting circuit.* Inspect cables in lighting system circuit (fig. 76); repair or replace cable, or cables, as necessary.

f. Frequent Light Failure.

(1) *Faulty generator regulator.* Frequent burning out of lamp filaments is a result of high voltage, caused by an improperly adjusted generator regulator or faulty generator regulator. Replace generator regulator (par. 119).

(2) *High resistance in cable.* Check cables for condition and replace cables which are found to be faulty.

g. Stop Lights Fail To Operate.

(1) *Burned out lamps.* Replace stop light lamps (par. 131).

(2) *Faulty light switch.* Replace light switch (par. 145).

(3) *Faulty stop light switch.* Replace stop light switch (par. 148).

(4) *Grounded or open cables.* Inspect stop light circuit for grounded or open cables and repair or replace as necessary.

(5) *Loose or corroded terminals.* Clean and tighten all cable connections.

73. Instrument Cluster, Instruments, Gages, Switches, and Sending Units

a. Speedometer Inoperative.

(1) *Broken or kinked speedometer cable.* Disconnect speedometer cable and replace defective cable (par. 141).

(2) *Faulty speedometer.* Replace speedometer (par. 141.)

(3) *Broken or stripped speedometer drive gear.* If the speedometer cable and speedometer are checked and found to be in good condition, it indicates a broken or stripped speedometer drive gear. Notify ordnance maintenance personnel.

b. Ammeter Inoperative. Refer to paragraph 70.

c. Engine Oil Pressure Gage Inoperative.

(1) *Low oil viscosity.* Drain engine oil and refill crankcase with correct grade (par. 53) of engine oil.

(2) *Faulty oil pressure gage.*

(*a*) To determine whether voltage is present at the gage, disconnect "positive" lead from the gage and with a voltmeter check for presence of 24 volts with the ignition switch on.

(*b*) Check instrument by substituting a known "good" gage.

(*c*) If neither (*a*) nor (*b*) above checks locate the trouble, disconnect the lead from the oil pressure sending unit and with a voltmeter check for presence of approximately 24 volts on the wire end with the ignition switch on. If no reading is obtained, the cable is either open or grounded.

(*d*) If trouble is still not apparent in (*a*), (*b*), or (*c*) above, replace the oil pressure sending unit.

d. Fuel Gage Inoperative.

(1) *Lack of fuel in fuel tank.* Fill fuel tanks with proper octane fuel.

(2) *Faulty fuel gage.*

(*a*) To determine whether voltage is present at the gage, disconnect "positive" lead from the gage and with a voltmeter check for presence of 24 volts with the ignition switch on.

(*b*) Check instrument by substituting a known "good" gage.

(*c*) If neither (*a*) nor (*b*) above checks locate the trouble, disconnect the lead from the fuel sending unit and with a voltmeter check for presence of approximately 24 volts on the wire end with the ignition switch on. If no reading is obtained. the cable is either open or grounded.

(*d*) If trouble is still not apparent in (*a*), (*b*), or (*c*) above, replace the fuel sending unit.

e. Engine temperature Gage Inoperative.

(1) *Engine thermostat sticking open.* If the vehicle is being operated in extreme cold weather conditions and the thermostat is sticking open, the engine coolant may not heat sufficiently to register normal temperature on the gage. Place a paulin or winterfront cover over the radiator and run engine at fast idle. If temperature gage registers temperature, thermostat is at fault. Replace thermostat (par. 125).

(2) *Faulty temperature gage.*

(*a*) To determine whether voltage is present at the gage, disconnect "positive" lead from the gage and with a voltmeter check for presence of 24 volts with the ignition switch on.

(*b*) Check instrument by substituting a known "good" gage.

(*c*) If neither (*a*) nor (*b*) above checks locate the trouble, disconnect the lead from the temperature sending unit and with a voltmeter check for presence of approximately 24 volts on the wire end with the ignition switch on. If no reading is obtained, the cable is either open or grounded.

(*d*) If trouble is still not apparent in (*a*), (*b*), or (*c*) above, replace the temperature sending unit.

f. One Instrument Panel Light Fails to Light.

(1) *Burned out lamp.* Replace defective lamp (par. 143).

(2) *Loose or faulty cable.* Examine cable connections at instrument panel light and light switch for evidence of loose or faulty cable. Tighten terminal connections or replace defective cable. Inspect condition of cable connecting instrument panel light to light switch; if cable is found to be frayed, broken, or in otherwise unsatisfactory condition, replace cable.

(3) *Faulty instrument panel light assembly.* If the above conditions ((1) and (2)) were checked and light still does not burn, instrument panel light assembly is faulty. Replace instrument panel light assembly (par. 143).

g. Both Instrument Panel Lights Fail to Light.

(1) *Burned out lamps.* Replace lamps (par. 143).

(2) *Loose or faulty cables.* Refer to *f*(2) above.

(3) *Faulty instrument panel light assemblies.* Refer to *f*(3) above.

(4) *Faulty light switch.* If the above conditions were checked and instrument panel lights still do not light, it indicates a faulty light switch. Replace light switch (par. 145).

h. Both Windshield Wipers Fail to Operate.

(1) *Windshield wiper shut-off valve not turned completely on.* Turn windshield wiper shut-off valve on (par. 25).

(2) *Windshield wiper blades stuck to windshield glass due to heat, snow, or ice.* If windshield blade is struck to windshield glass due to extreme heat, remove windshield wiper blade and replace. If windshield wiper blade is stuck due to ice, carefully loosen blade rubber from ice and thaw with warm water, if available. If blade rubber is damaged, replace windshield wiper blade.

(3) *Loose vacuum line connections.* Check all vacuum line connections between the fuel pump and windshield wipers for evidence of a poor seal or leaks. Tighten connections or replace vacuum lines, tee, hoses, or connectors.

(4) *Plugged or kinked vacuum line from fuel pump to windshield wiper.* Examine all hoses and lines along the entire length of the windshield wiper vacuum system for evidence of a kinked or damaged hose or line. Replace all faulty hoses or lines. Disconnect vacuum lines at fuel pump and windshield wiper and blow out with compressed air.

(5) *Sticking paddles in windshield wipers.* Move windshield wiper handles back and forth to loosen paddles. Disconnect vacuum line at windshield wiper and insert SAE 40 engine oil into windshield wiper. Move windshield wiper handle to distribute oil and replace vacuum line. If the windshield wiper now operates, condition may be considered corrected. If windshield wipers do not operate, replace windshield wiper (par. 220).

i. Right Windshield Wiper Fails To Operate.

(1) *Hose between right and left windshield wiper loose or damaged.* Examine hose at connections and along entire length for indications of nicked, cracked, loose, or damaged portions. Replace hose or connections.

(2) *Sticking paddle in windshield wiper.* Refer to *h*(5) above.

74. Radio Interference Suppression System

a. Locate Source of Noise. To locate the source of radio interferences emanating from the vehicle, the use of a radio receiver in the vehicle or adjacent vehicle will be required. Noting the type of interference present in the receiver will help to determine the cause of the trouble. To determine if the noise is coming from the vehicle itself or from an outside source, drive the vehicle at least 100 feet from any other vehicle. Turn the engine off and turn the radio on. Any noise heard will be from an outside source. Start engine. Any noise now heard will come from the vehicle itself.

b. Engine.

(1) Operate engine with vehicle not in motion and listen for noises in the receiver. If a crackling or clicking noise is present, accelerate the engine and turn ignition switch off with engine running at high speed. If the noise stops immediately, the noise is being caused by the ignition system (*c* below). If an irregular clicking or chattering continues for a few seconds after the ignition is turned off, interference is being caused by the generating circuit (*d* below). If the interference is in the form of a whining or whirring noise which varies with engine speed, turn the ignition off. If the tone of the sound lowers in pitch but continues for a few seconds after ignition is turned off, it is caused by the generator (*e* below).

(2) Operate the vehicle and note whether there is any interference present in the receiver. If a clicking or scratching noise is present, stop the vehicle but leave the engine running. If noise stops when motion of vehicle stops, it may be attributed to loose cable connections or frayed cable insulation in vehicle wiring (*f* below).

c. Ignition Circuit. Make sure the ignition circuit is functioning properly (par. 68). Improper spark plug gaps, improper distributor breaker point adjustment, or worn parts will affect the suppression system. Clean and tighten all electrical connections. Tighten engine mountings. With engine running, disconnect cables from spark plugs, one at a time; if disconnecting any one of the cables reduces or eliminates the interference, the spark plug resistor or the resistor in the distributor cap is at fault. Replace spark plug (par. 114) or distributor cap (par. 113).

d. Generating Circuit. Check generator-regulator mounting bolts and tighten if necessary. Check wiring harness connecting generator to generator-regulator for broken or damaged insulation. Replace generator (par. 118) or generator-regulator (par. 119), if necessary.

e. Generator. Check and tighten generator mounting bolts. If noise is still present, replace generator (par. 118).

f. Inspect all wiring for worn, frayed, or otherwise damaged insulation. Replace if faulty. Clean and tighten all connections.

75. Clutch

a. Clutch Drags.

(1) *Excessive clutch pedal clearance.* Idle engine, depress clutch pedal to fully released position, and allow for clutch to stop rotating. Shift transmission into first or reverse gear. If the shift cannot be made without a severe clashing of gears, or if after engagement of the gears, there is a jumping or creeping movement of the vehicle with the clutch fully released, the clutch is dragging. Adjust clutch linkage (par. 156).

(2) *Warped or cracked clutch driven disk.* Replace clutch driven disk (par. 157).

(3) *Faulty clutch.* Replace clutch (par. 157).

b. Clutch Slips.

(1) *Insufficient clutch pedal free travel.* Adjust clutch linkage (par. 156).

(2) *Worn clutch driven-disk facing.* Replace clutch driven-disk (par. 157).

(3) *Grease or oil on clutch driven-disk facings.* Replace clutch driven disk (par. 157).

(4) *Faulty clutch.* Replace clutch (par. 157).

c. Clutch Chatters.

(1) *Clutch linkage improperly adjusted.* Adjust clutch linkage (par. 156).

(2) *Oil or grease on clutch driven-disk facings.* Replace clutch driven-disk (par. 157).

(3) *Improper connections.* Inspect transmission mounting, propeller shafts, universal joints, and engine mountings for loose connections. Tighten connections as necessary.

d. Clutch Squeels When Released.

(1) *Improperly adjusted clutch linkage.* Adjust clutch linkage (par. 156).

(2) *Oil or grease on clutch pressure plate.* Replace clutch (par. 157).

(3) *Worn clutch release bearing.* Notify ordnance maintenance personnel.

(4) *Dry clutch shaft or flywheel bearing.* Notify ordnance maintenance personnel.

e. *Clutch Pedal Pressure Excessively Stiff.*

(1) *Insufficient clutch linkage lubrication.* Lubricate clutch linkage as directed on lubrication chart (par. 53).

(2) *Bent or damaged parts in clutch linkage.* Adjust clutch linkage (par. 156) and replace broken or damaged parts.

(3) *Faulty clutch.* Replace clutch (par. 157).

76. Transmission

a. *Transmission Will Not Go Into Any Gear.*

(1) *Improper clutch linkage adjustment.* Adjust clutch linkage (par. 156).

(2) *Incorrect grade of oil.* If this condition is encountered in extreme cold weather, transmission oil may be too stiff. Drain and replace transmission oil with correct grade (par. 53).

(3) *Faulty clutch.* Replace clutch (par. 157).

(4) *Damaged or seized gears, shafts, or forks in transmission.* Replace transmission (pars. 160 and 161).

b. *Excessive Noise.*

(1) *Insufficient lubrication or incorrect grade of oil.* Check transmission for presence of proper grade of oil. Lubricate as specified on the lubrication chart (par. 53). If oil is of improper viscosity, drain and refill transmission with correct grade oil (par. 53).

(2) *Worn or damaged gears, bearings, or shafts in transmission.* Replace transmission (pars. 160 and 161).

(3) *Worn or damaged gears, bearings, or shafts in transfer.* Often times noises originating in the vicinity of the transmission are due to faulty parts within the transfer. Place transmission in neutral and run engine. If noise is now excessive, trouble is in transmission. Replace transmission (pars. 160 and 161). If noise is audible only when transfer is engaged, replace transfer (pars. 164 and 165).

c. *Hard Shifting.*

(1) *Clutch fails to release.* If clashing of gears is encountered when attempting to shift from neutral to low gear, the clutch is not fully releasing. Adjust clutch linkage (par. 156) or replace clutch (par. 157).

(2) *Incorrect grade of oil.* Refer to *a*(2) above.

(3) *Faulty parts in transmission.* Replace transmission (pars. 160 and 161).

d. Transmission Slips Out Of Gear.

(1) *Bent shifting fork.* Notify ordnance maintenance personnel or replace transmission (pars. 160 and 161).

(2) *Weak or broken shift poppet springs.* Notify ordnance maintenance personnel.

(3) *Excessively worn transmission gears.* Notify ordnance maintenance personnel or replace transmission (pars. 160 and 161).

(4) *Excessive end play of transmission main shaft.* Notify ordnance maintenance personnel.

(5) *Excessive end play of transmission countershaft gear.* Notify ordnance maintenance personnel.

e. Transmission leaks lubricant.

(1) *Loose drain plug.* Tighten or replace drain plug.

(2) *Loose mounting bolts or cap screws.* Tighten or replace mounting bolts or cap screws. Tighten all cover cap screws.

(3) *Damaged or defective oil seals or gaskets.* Notify ordnance maintenance personnel.

77. Transfer

a. Transfer Shift Levers Fail To Shift Into Gear Or Shift Hard.

(1) *Insufficient lubrication or improper grade of lubricant.* Check lubricant level. Drain and refill transfer with correct grade lubricant (par. 53).

(2) *Transfer not properly alined with transmission.* Remove transfer and replace (par. 164 and 165).

(3) *Worn or damaged gears, shafts, bearings, or forks.* Notify ordnance maintenance personnel or replace transfer (pars. 164 and 165).

b. Excessive Noise.

(1) *Insufficient lubrication.* Check level of lubricant in transfer. If level is low, add lubricant. If lubricant is of incorrect viscosity, drain and refill.

(2) *Worn gears, bearings, or shafts in transfer.* If noise occurs only when transfer is in operation (vehicle moving), it is most likely due to worn parts in transfer. Replace transfer (pars. 164 and 165) or notify ordnance maintenance personnel. Refer to paragraph 76*b*(3) for test to determine if noise is attributed to transmission or transfer. If transmission is at fault, notify ordnance maintenance personnel or replace transmission (pars. 160 and 161).

(3) *Transfer improperly alined with transmission.* Remove transfer (par. 164) and aline with transmission.

(4) *Loose or damaged propeller shafts.* Replace either front or rear propeller shafts (pars. 167 and 168).

c. Transfer Slips Out of Gear.

(1) *Bent shifting forks.* Notify ordnance maintenance personnel or replace transfer (pars. 164 and 165).

(2) *Weak or broken shift rail poppet springs.* Notify ordnance maintenance personnel or replace transfer (pars. 164 and 165).

(3) *Excessively worn gears or shafts.* Notify ordnance maintenance personnel or replace transfer (par. 164).

d. Transfer Leaks Lubricant.

(1) *Loose or damaged drain plug.* Tighten or replace drain plug.

(2) *Loose mounting or cover plate bolts or cap screws.* Tighten or replace mounting or cover plate bolts or cap screws.

(3) *Damaged gaskets or oil seals.* Notify ordnance maintenance personnel.

78. Propeller Shafts

a. Propeller Shaft Backlash.

(1) *Worn or damaged universal joint bearings, yokes, or trunnions.* Replace faulty universal joints or propeller shafts (pars. 167 and 168).

(2) *Loose bolts at propeller shaft companion flanges or loose "U" bolts.* Tighten or replace loose "U" bolts.

(3) *Broken splines at propeller shaft yoke.* Replace propeller shaft (pars. 167 and 168).

b. Excessive Noise or Vibration.

(1) *Worn or damaged universal joints.* Notify ordnance maintenance personnel.

(2) *Bent or distorted propeller shaft.* Replace propeller shaft (pars. 167 and 168).

(3) *Insufficient lubrication.* Lubricate universal joints and propeller shafts as described in the lubrication chart (par. 53).

(4) *Loose companion flange bolts or "U" bolts.* Tighten or replace bolts.

(5) *Broken splines on propeller shaft yokes.* Replace propeller shaft (pars. 167 and 168).

79. Front Axle

a. Hard Steering.

(1) *Insufficient lubrication.* Lubricate front axle steering knuckle, tie rod ends, and drag link ends as directed on the lubrication chart (par. 53).

(2) *Tight steering gear.* Refer to paragraph 83.

(3) *Bind in steering knuckle.* Raise front wheels from ground and disconnect drag link at front axle (par. 205). Turn wheels and tie rod from side to side. If bind exists, disconnect one end of tie rod from steering knuckle (par. 172). Test each wheel, turning from side to side. If bind persists and lubrication does not correct the condition, replace front axle (pars. 179 and 180).

(4) *Improper toe-in.* Check toe-in of front wheels (par. 171*a*). If toe-in is not within $\frac{3}{64}$- to $\frac{3}{32}$-inch limits, adjust tie rods (par. 171*b*).

(5) *Tires underinflated.* Check tire pressure using an accurate gage (par. 211) and inflate tires to proper pressure for terrain being encountered (par. 211).

(6) *Excessive caster.* Checking of front axle caster requires special equipment. Notify ordnance maintenance personnel.

(7) *Bent or damaged tie rods or drag link.* Replace faulty tie rods (par. 172) or drag link (par. 205).

b. Front End Shimmys.

(1) *Excessive looseness within front axle.* Raise front wheels from ground and move front wheels from side to side and up and down. If excessive looseness exists, replace front axle (pars. 179 and 180).

(2) *Loose or worn tie rods or drag link.* Replace all loose or worn tie rods (par. 172) or drag link (par. 205).

(3) *Bent wheel.* Replace wheel (par. 210).

(4) *Loose wheel nuts.* Tighten wheel nuts (par. 210).

(5) *Loose or improperly adjusted front wheel bearings.* Adjust or replace front wheel bearings (par. 174).

(6) *Insufficient front wheel toe-in.* Refer to *a*(4) above.

(7) *Excessive caster.* Refer to *a*(6) above.

c. Vehicle Wanders.

(1) *One tire underinflated.* Check front tire pressure and inflate to proper and equal pressure (par. 211).

(2) *Loose or improperly adjusted front wheel bearings.* Refer to *b*(5) above.

(3) *Improperly adjusted steering gear.* Adjust steering gear (par. 208).

(4) *Loose or worn tie rods or drag link.* Replace tie rods (par. 172) or drag link (par. 205).

(5) *Loose or worn parts in front axle.* Replace front axle (pars. 179 and 180).

(6) *Incorrect steering geometry due to accident.* Notify ordnance maintenance personnel.

d. Excessive Noise in Front Axle.

(1) *Loose and vibrating front propeller shaft.* Replace front propeller shaft (pars. 167 and 168).

(2) *Insufficient lubrication.* Lubricate front axle as prescribed in the lubrication chart (par. 53).

(3) *Worn front axle differential gears.* Replace front axle (pars. 179 and 180).

(4) *Worn front axle shafts or front axle universal joints.* Replace front axle (pars. 179 and 180).

(5) *Front wheel bearings worn or adjusted too tight.* Adjust (par. 174*a*) or replace(par. 174*b* and *c*) front wheel bearings.

e. Lubricant Leakage.

(1) *Loose drain plug.* Tighten or replace drain plug.

(2) *Loose carrier housing cover cap screws or damaged cover gaskets.* Tighten carrier housing cover cap screws or replace cover gasket.

(3) *Faulty steering knuckle oil seals.* Replace steering knuckle oil seal (par. 178).

80. Rear Axle

a. Continuous Rear Axle Noise.

(1) *Insufficient lubrication.* Lubricate rear axle as prescribed in the lubrication chart (par. 53).

(2) *Tires improperly inflated or unequally worn.* If rear axle noise is caused by tires, the noise will disappear when the vehicle is driven on soft ground. Inflate tires equally (par. 211) or replace tires (par. 211).

(3) *Rear axle shaft bearings worn, improperly adjusted, or inadequately lubricated.* Repack, adjust, or replace rear axle shaft bearings as condition warrants after check (par. 183).

(4) *Worn or improperly adjusted rear axle differential gears and bearings.* Notify ordnance maintenance personnel or replace rear axle (pars. 187 and 188).

(5) *Loose or damaged rear propeller shaft.* Replace rear propeller shaft (pars. 167 and 168).

b. Rear Axle Noise in Drive Only or in Coast Only.

(1) *Rear axle shaft bearings worn, improperly adjusted, or inadequately lubricated.* Refer to *a*(3) above.

(2) *Drive pinion and drive gear out of adjustment or worn.* Notify ordnance maintenance personnel or replace rear axle (pars. 187 and 188).

c. Excessive Backlash in Axle Driving Parts.

(1) *Axle flange cap screws or nuts loose.* Tighten nuts or cap screws.

(2) *Drive gear and drive pinion out of adjustment.* Replace rear axle assembly (pars. 187 and 188).

d. Lubricant Leakage.

(1) *Loose drain plug.* Tighten or replace drain plug.

(2) *Loose carrier housing cover cap screws or damaged cover gasket.* Tighten carrier housing cover cap screws or replace cover gasket.

(2) *Faulty rear axle grease retainer.* Replace grease retainer (par. 184).

81. Brake System

a. Service Brake Pedal Depresses to Floor.

(1) *Normal wear of brake lining.* When brake linings become worn, it becomes necessary to set the brake shoes closer to the brake drums. Adjust service brakes (par. 191*a*).

(2) *Brake shoes improperly adjusted.* Adjust brake shoes (par. 191*a*).

(3) *Insufficient brake fluid in brake system.* Refill brake master cylinder with brake fluid (par. 192).

(4) *Air in brake lines.* Air in the brake lines will cause a spongy or springy action of the service brake pedal. Bleed brake lines (par. 195) and refill brake system (par. 195).

(5) *Brake fluid leak.* Inspect underneath of chassis for signs of brake fluid leaks at brake master cylinder, brake wheel cylinders, and brake lines and connections. Correct leaks by replacement of damaged brake lines (par. 194), brake master cylinder (par. 192), or brake wheel cylinders (par. 193). Refill brake system with brake fluid (par. 195).

(6) *Service brake pedal improperly adjusted.* The service brake pedal must have approximately ¼- to ½-inch free-travel before meeting resistance. Additional free-travel reduces the normal travel of the brake master cylinder piston, which in turn limits the amount of working brake fluid to be expelled or forced out of the brake master cylinder. Adjust brake pedal travel (par. 191*a*).

b. All Brakes Drag.

(1) *Mineral oil in brake fluid.* The introduction of mineral oil into the hydraulic brake fluid in the brake system will cause the brake wheel piston cups to swell and retard or prevent

their action. Bleed entire brake system (par. 195) and refill with brake hydraulic fluid (par. 195). If this does not remedy the condition, report to ordnance maintenance personnel, as the complete service brake system will have to be reconditioned.

(2) *Service brake pedal improperly adjusted.* Refer to *a*(6) above.

c. One Brake Drags.

(1) *Brake shoes improperly adjusted.* Adjust brake shoes (par. 191*a*).

(2) *Brake shoes seized.* Lubricate brake shoe bearing surfaces.

(3) *Weak or broken brake shoe return spring.* Replace defective brake shoe return spring (par. 191).

d. Vehicle Pulls to One Side When Brakes Are Applied.

(1) *Tires improperly inflated.* Equalize tire pressure (par. 211).

(2) *Improperly adjusted brake shoes.* Adjust brake shoes (par. 191*a*).

(3) *Grease soaked brake linings.* Replace brake shoes (par. 191).

e. Springy or Spongy Service Brake Pedal Action.

(1) *Brake shoes improperly adjusted.* Adjust brake shoes (par. 191*a*).

(2) *Air in brake system.* Bleed brake system (par. 195) and refill brake master cylinder with brake hydraulic fluid (par. 195).

(3) *Brake fluid level low in brake master cylinder.* This will make it necessary for the operator to pump service brake pedal to gain sufficient braking effort. Fill brake master cylinder with brake fluid (par. 195).

f. Severe Braking Action From Light Service Brake Pedal Pressure.

(1) *Oil or grease soaked brake linings.* This condition results from leaking oil seals. Replace brake shoes (par. 191).

(2) *Improperly adjusted brake shoes.* Adjust brake shoes (par. 191*a*).

(3) *Loose brake backing plate.* Notify ordnance maintenance personnel.

g. Weak Braking Action From Heavy Service Brake Pedal Pressure.

(1) *Improperly adjusted brake shoes.* Adjust brake shoes (par. 191*a*).

(2) *Water in brakes.* This condition could also result directly after emerging from a fording operation. Allow brake shoes to dry. If, after drying, brake action is still weak, adjust brake shoes (par. 191*a*) or replace brake shoes (par. 191).

(3) *Air in brake system.* Bleed brake system (par. 195) and refill with brake fluid (par. 195).

(4) *Oil or grease on brake linings.* Replace brake shoes (par. 191).

h. Parking Brake Control Handle Pulls Up but Fails To Apply Parking Brakes.

(1) *Parking brake not adjusted.* Adjust parking brake (par. 196*a*).

(2) *Parking brake linings worn.* Replace brake shoes (par. 196*b*).

(3) *Broken parking brake control rod.* Replace broken parking brake control rod (par. 196).

i. Parking Brake Does Not Hold Parked Vehicle.

(1) *Parking brake not adjusted.* Adjust parking brake (par. 196*a*).

(2) *Worn brake linings.* Replace brake shoes (par. 196*b*).

(3) *Oil or grease on brake linings.* Replace brake shoes (par. 196*b*).

j. Parking Brake Drags and Overheats.

(1) *Vehicle operated with parking brake partially applied.* Make sure parking brake control handle is fully released.

(2) *Parking brake adjusted too tight.* Adjust parking brake (par. 196*a*).

(3) *Parking brake drum out of round.* Replace parking brake drum (196*c*).

82. Springs and Shock Absorbers

a. Insufficient Flexibility (Hard Riding).

(1) *Insufficient spring shackle lubrication.* Lubricate spring shackle as prescribed on the lubrication chart (par. 53).

(2) *Frozen spring shackles.* Free up, lubricate (par. 53), and adjust spring shackle.

(3) *Faulty shock absorbers.* Disconnect shock absorber and test shock absorber action. If shock absorber is inoperative, replace (par. 202).

b. Excessive Flexiblity (Extremely Soft Ride).

(1) *Overlubrication.* Clean excess grease from side of spring leaves. Lubricate at intervals specified on lubrication chart (par. 53).

(2) *Shock absorbers inoperative (no fluid).* Disconnect shock absorber and test action. If little or no resistance is felt, replace shock absorber (par. 202).

(3) *Broken spring leaves.* Examine springs for broken spring leaves and, if found, replace spring (par. 201).

c. Vehicles Sags to One Side.

(1) *Overload condition.* Examine weight distribution of load and shift to equalize if possible.

(2) *Weak springs.* This is usually caused by careless operation on unusual terrain. Review operating instructions for unusual terrain (par. 48). Replace weak spring (par. 201).

(3) *Broken spring leaf.* Examine springs for broken spring leaves and, if found, replace spring (par. 201).

(4) *Underinflated tire.* Examine and check pressure of tires. Inflate the tires to proper pressure (par. 211).

d. Excessive Spring Noise.

(1) *Worn spring pivot bolts or spring shackles.* Use a pry bar to test wear of spring shackles or spring pivot bolts. Replace spring shackles (par. 199) or spring pivot bolts (par. 200) as necessary.

(2) *Inadequate lubrication.* Lubricate springs as prescribed on the lubrication chart (par. 53).

(3) *Worn or faulty shock absorber.* Replace shock absorber if found to be loose or worn (par. 202).

(4) *Loose spring center bolt.* This will cause spring leaves to shift and squeak. Replace spring (par. 201).

e. Repeated Spring Leaf Failure or Breakage.

(1) *Loose spring clips.* Tighten spring clips.

(2) *Overloading and improper operation on rough terrain.* Breakage of vehicle springs is most commonly caused by overloading the vehicle or by driving at excessive speeds over

rough terrain. Refer to vehicle identification plate (fig. 4) for maximum load, and reduce vehicle speed over rough terrain where possible.

(3) *Spring leaf failure at spring eye.* Spring failures at this point are generally caused by tight spring shackles or frozen pivot bolts. Lubricate, free up, and adjust spring shackles or replace spring (par. 201).

(4) *Spring leaf failure at center section of spring.* Breakage of spring leaves at the spring center bolt section are generally caused by loose spring clips. Replace spring (par. 201) and tighten spring clips securely.

83. Steering System

a. General. Many complaints of steering difficulties are falsely charged to the steering system. In order, therefore, to isolate the steering system from balance of front axle and connections, the drag link should be disconnected from the Pitman arm at the steering gear assembly (par. 205). This will permit an unobstructed diagnosis of the steering system. Refer to front axle trouble shooting (par. 79) when trouble shooting steering system. In general, steering complaints rightfully traceable to the steering gear are indicated below.

b. Hard Steering.

(1) *Insufficient lubrication.* Lubricate steering gear as prescribed on the lubrication chart (par. 53).

(2) *Tight steering gear.* Turn steering wheel from one extreme to the other. If tightness or a bunching condition is felt, adjust steering gear (par. 208).

(3) *Damaged bearings or internal parts.* If rough spots, bumps, or noise are encountered while turning steering wheel, internal damage is indicated. Notify ordnance maintenance personnel.

(4) *Steering column misalined causing binding.* Loosen steering column bracket mounting at instrument panel. If binding condition is relieved, hold steering column in position and tighten bracket mounting.

c. Wander or Weaving.

(1) *Loose steering gear mounting.* Tighten steeering gear mounting bolts.

(2) *Steering gear improperly adjusted.* Adjust steering gear (par. 208).

(3) *Worn or damaged parts in steering gear.* Notify ordnance maintenance personnel.

(4) *Worn drag link.* Replace drag link (par. 205).

(5) *Improper steering geometry due to accident.* Notify ordnance maintenance personnel.

d. Oil Leaks.

(1) *Worn oil seal in steering gear housing.* Notify ordnance maintenance personnel.

(2) *Loose housing cover or leaking housing cover gasket.* Tighten cover or notify ordnance maintenance personnel.

84. Wheels and Tires

a. Excessive or Uneven Tire Wear.

(1) *Unequal tire pressures.* Inflate all tires to equal pressure (par. 211).

(2) *Improper front wheel alinement.* Check front wheel alinement (par. 170).

(3) *Bent wheel.* Replace wheel (par. 210).

(4) *Damaged or improperly adjusted wheel bearings.* Check wheel bearings and adjust or replace as necessary (par. 174).

(5) *Wheel stud nuts loose.* Tighten wheel stud nuts (par. 210).

(6) *Wheel out of balance.* Remount wheel correctly (par. 210).

b. Wheel Wobbles.

(1) *Bent wheel.* Replace bent wheel (par. 210).

(2) *Wheel loose on wheel hub.* Tighten flange stud nuts (par. 210).

(3) *Damaged or improperly adjusted wheel bearings.* Refer to *a* (4) above.

(4) *Wheel out of balance.* Remount wheel correctly (par. 210).

c. Wheel Pounds.

(1) *Damaged or improperly adjusted wheel bearings.* Refer to *a* (4) above.

(2) *Wheel bent.* Replace bent wheel (par. 210).

(3) *Damaged tire.* Examine tire for signs of a break or a boot. Replace tire (par. 211).

Section V. ENGINE DESCRIPTION AND MAINTENANCE IN VEHICLE

85. Description and Data

a. Description.

(1) *Engine.* The engine is a four-cylinder, liquid-cooled, gasoline engine of the F-head design. This design is a combination valve-in-head and valve-in-block construction. The four intake valves are located in the cylinder head while the exhaust valves (fig. 30) are located in the cylinder block. The intake valves are operated by intake valve push rods (fig. 30) through valve rocker arms (fig. 27) in a conventional overhead manner. The exhaust valves are operated by valve tappets (fig. 30) in the cylinder block. To facilitate major repairs, the engine, transmission, transfer, and radiator are designed so that they may be removed from the vehicle as a complete unit, called the power plant (figs. 42 and 43). The operations covering the removal of the power plant are outlined in chapter 3, section VI.

(2) *Intake and exhaust manifolds.* The intake manifold is of the sealed-in type, cast directly into, and considered a part of, the cylinder head. The exhaust manifold (fig. 22) is attached to the left side of the cylinder block and secured by safety nuts. The exhaust manifold is a single cast unit with exhaust ports in the exhaust manifold registering with exhaust ports in the cylinder block. The purpose of the exhaust manifold is to direct the exhaust gases created by the engine during combustion to the exhaust pipe and muffler (figs. 22 and 55). The sealed-in intake manifold distributes the fuel-air mixture from the carburetor to the combustion chambers.

(3) *Engine oil pan* (fig. 43). The engine oil pan is made of stamped steel, flanged and shaped to conform to the contour of the bottom of the cylinder block. The engine oil pan holds the lubricating oil for the engine. A drain plug (fig. 43) is provided at the bottom left edge of the engine oil pan to drain the engine oil. A skid plate (fig. 43) is welded to the bottom of the engine oil pan to provide protection when traveling over rough terrain. Also attached to the front of the oil pan is a crankshaft pulley shield (fig. 43) to provide protection for the crankshaft pulley.

(4) *Engine oil filter* (fig. 23). Two types of engine oil filters are used, the replaceable element type and the cuno, or non-

replaceable element type. Both engine oil filters are mounted near the front on the right side of the engine. A portion of the engine oil is continuously passed through the engine oil filter where foreign materials are removed before it is returned to the engine oil pan.

(5) *Crankcase ventilation.* Positive ventilation for the engine crankcase is provided through a separate ventilation system. This ventilation system provides fresh air to the engine and removes the harmful gasses produced when the engine is operating either on dry land or completely submerged in water. Fresh air is drawn in through the carburetor air cleaner (fig. 45) and passes through the air intake hose (fig. 45) and air intake pipe (fig. 45) to the upper crankcase ventilator control valve (fig. 32). Ventilation hoses (fig. 32) connect the upper crankcase ventilator control valve to the oil filter pipe and intake valve cover (fig. 25). The circulation of the air within the engine is controlled by the lower crankcase ventilator control valve (fig. 33) located on the exhaust valve cover. The crankcase ventilator control valves can be manually closed when submerged in water by operating the crankcase ventilator valves control (fig. 6) on the instrument panel.

(6) *Engine lubrication.* Positive lubrication of the engine is provided by a gear driven oil pump and floating oil screen in the engine. This oil pump delivers oil under pressure to drilled oil passages and external oil pipes and lines which in turn directs engine oil to all moving parts of the engine.

(7) *Engine nomenclature.* The fan end of the engine will be referred to as the "front." The flywheel end of the engine will be referred to as the "rear." The terms "left" and "right" are used with reference to the engine as viewed from the flywheel or "rear" of the engine and looking toward the front. Cylinders are numbered from the front starting with the first cylinder. Viewing the engine from the front, the crankshaft rotates in a clockwise direction.

b. Data.

Manufacturer	Willys
Type	F-head
Cylinders	4
Bore	3⅛ in
Stroke	4⅜ in
Piston displacement	134.2 cu in
Horsepower at 4,000 rpm	72
Torque at 2,000 rpm	114 lb-ft
Firing order	1-3-4-2

Valve clearance:	
Intake	0.018 in
Exhaust	0.016 in
Weights:	
Power plant	680.81 lb
Engine, less accessories	365.15 lb
Engine, with accessories	499.65 lb
Oil capacities:	
With oil filter	5 qt
Without oil filter	4 qt

86. Engine Tune-Up

a. General. Engine tune-up is an orderly process of checking the engine and engine accessories to determine if various units are within original specifications, and to make any necessary adjustments, repairs, or replacements necessary to restore or maintain proper engine performance. Tune-up procedure can be accomplished at regular intervals or whenever engine performance indicates need for tune-up operations.

b. Engine Compression Test. The conventional type compression gage is used to check compression at each cylinder.

(1) Raise hood and remove all spark plugs (par. 114).

(2) Pull throttle control out to wide open position.

(3) Insert compression gage (fig. 20) in spark plug opening in cylinder head and crank engine with starter. Note compression reading on compression gage. Reset compression gage to zero after checking each cylinder. Record compression pressure for each cylinder on DA Form 461.

(4) Compare compression pressures of each cylinder. Normal compression pressure is 135 psi at starter speed of 185 rpm. Minimum compression is 100 psi. Readings of cylinder pressures should not vary more than 20 psi. If pressures do vary more than 20 psi, or is lower than 100 psi, notify ordnance maintenance personnel.

Note.—Notification to ordnance maintenance personnel need not be made immediately if readings vary or are low. Perform the engine tune-up sequence (*d* below) and check compression after vehicle has operated for at least 100 miles. Then if compression varys or is low, take necessary action.

c. Manifold Vacuum Test. Use of a vacuum gage before and after engine tune-up is helpful in checking engine performance. When engine is operating properly, the vacuum gage indicator will be steady and show highest reading when the engine is idling.

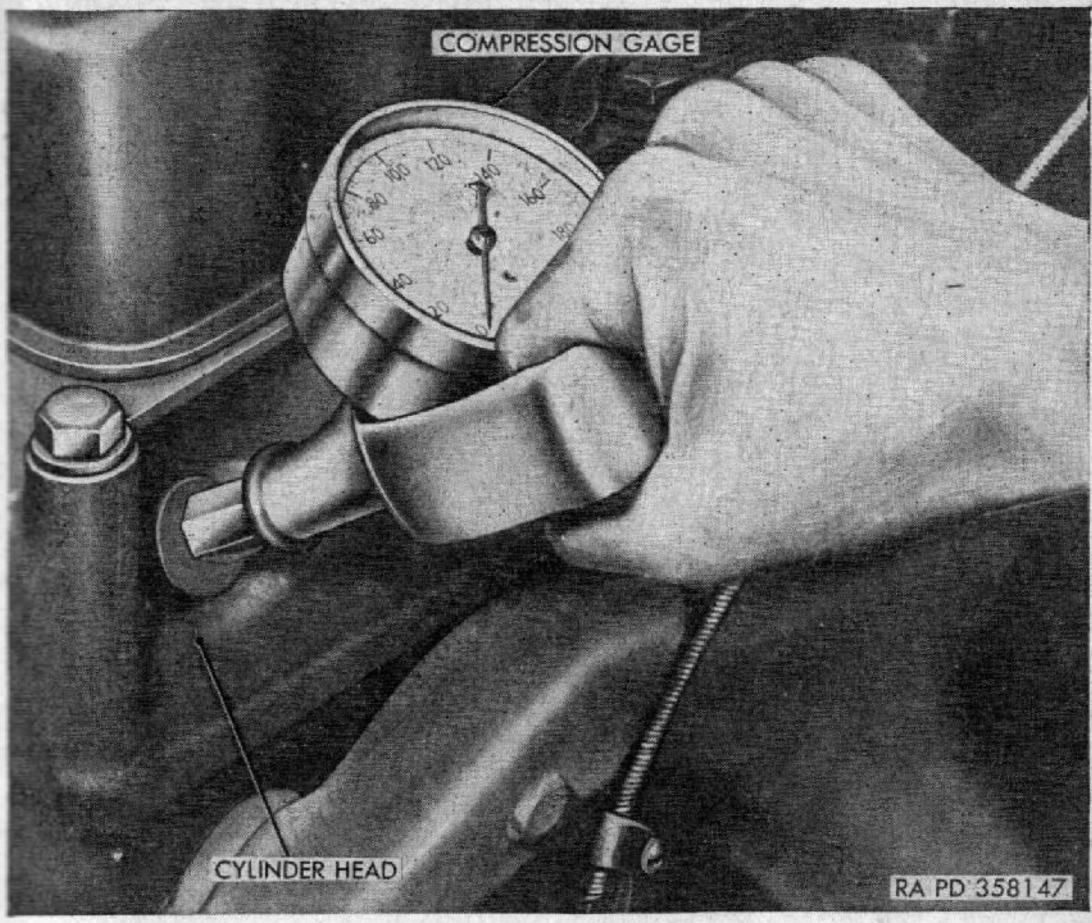


Figure 20. Checking engine compression.

(1) Disconnect fuel pump vacuum booster line (fig. 21) from elbow or right side of cylinder head below carburetor. Attach vacuum gage adapter (fig. 21) to elbow.

(2) Start engine and run at idling speed until minimum operating temperature (160° F.) is reached. Check carburetor adjustments (par. 102). With the engine running at normal idling speed, vacuum gage (fig. 21) should show a reading of 18 to 21 inches of mercury and pointer should be steady. A pointer fluctuating between 10 and 15 inches of mercury may indicate a leaking valve or defective cylinder head gasket. An abnormally low reading with the pointer steady may indicate a leak at the carburetor.

(3) Accelerate and decelerate the engine quickly. Vacuum should drop to approximately 2 inches of mercury with rapid acceleration and should rise to 24 inches of mercury as acceleration is decreased quickly with the engine running fast. If this action is not obtained, diluted engine oil, worn piston

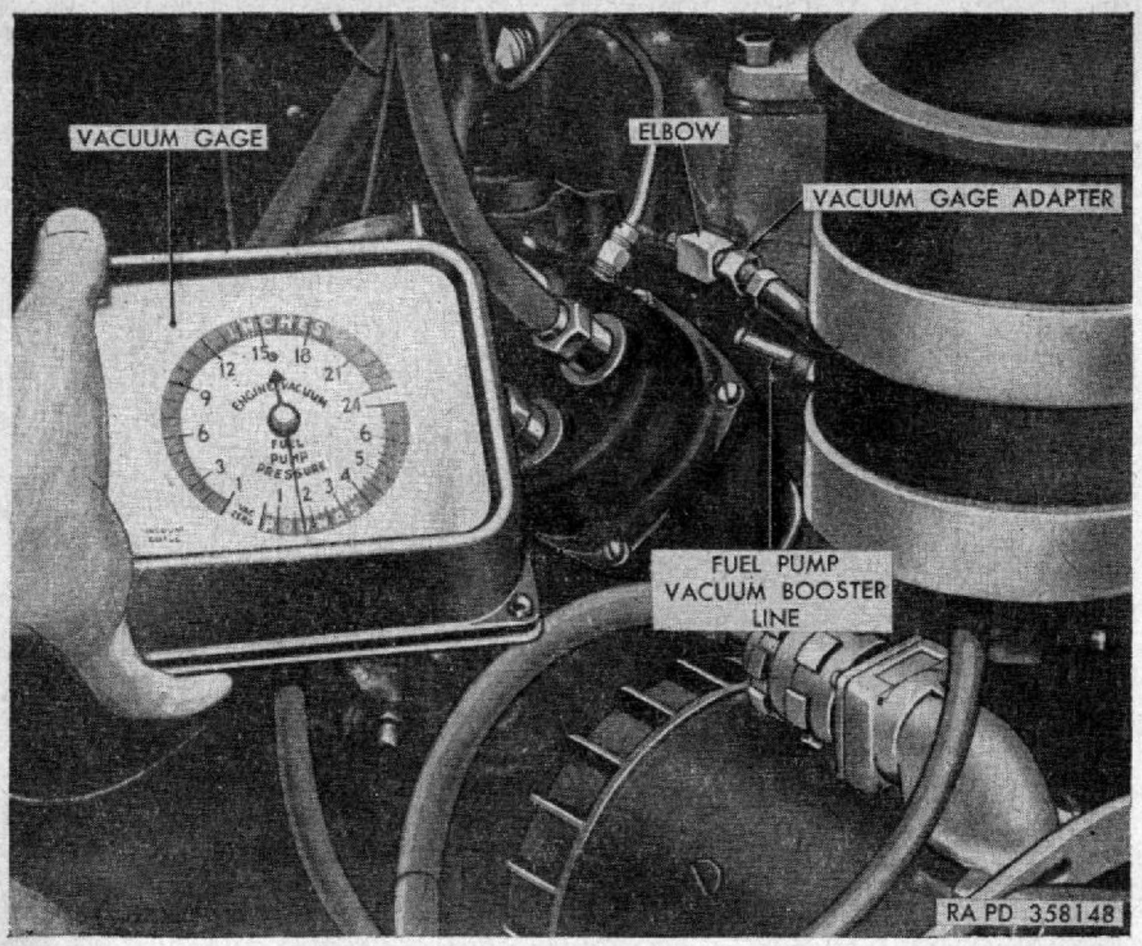


Figure 21. Checking intake manifold vacuum.

rings, or an abnormal restriction in carburetor, carburetor air cleaner, or exhaust system may be indicated.

Note.—Above readings are for sea level operation. Vacuum gage readings will be lowered approximately 1 inch of mercury for each 1,000 feet increase in altitude.

d. Engine Tune-Up Sequence. Perform operations in the order listed to properly tune engine. Paragraphs in which specific instructions occur are given for reference.

(1) *Compression and manifold vacuum tests.* Perform cylinder compression test (*b* above) and manifold vacuum test (*c* above).

(2) *Spark plugs.* Clean and inspect spark plugs (par. 114). Adjust spark plug gap (par. 114) to correct specifications.

(3) *Battery and ignition cables.* Check battery electrolyte level and battery specific gravity (par. 127). Clean battery and cable connections (par. 127). Tighten all battery terminals (fig. 78). Inspect ignition cables and spark plug cables (fig. 57) for cracks, loose connections, or oil soaked condition. Replace all unserviceable ignition or spark plug cables (par. 114). Refer to figure 56 for ignition system circuit.

(4) *Distributor and ignition timing.* Inspect distributor breaker points (fig. 62) for condition and check distributor breaker point gap (par. 113). Check, and if necessary, reset ignition timing (par. 112).

(5) *Valve clearances.* Check cylinder head cap screws for proper torque (par. 91). Check and adjust intake valve clearance (par. 92*a*). Check and adjust exhaust valve clearances (par. 92*b*).

(6) *Carburetor.* Check carburetor flange nuts (fig. 48) and air intake hose clamps for security. Adjust carburetor idling mixture (par. 102) and idling speed (par. 102).

(7) *Exhaust manifold.* Tighten exhaust manifold safety nuts where exhaust manifold (fig. 22) is attached to the engine and to the exhaust pipe to prevent leaks.

(8) *Fuel system.* Check fuel pump operation and refer to paragraph 66 for method of testing fuel pump pressure. Check all fuel and vacuum lines for leaks and good condition.

(9) *Carburetor air cleaner.* Service carburetor air cleaner (fig. 45) in accordance with instruction in paragraph 107.

87. Maintenance Operations

Most organizational maintenance operations on the engine and engine accessories can be performed with the engine installed in the vehicle. These maintenance operations, with a reference to the specific paragraph for detailed instructions, are listed below:

a. Carburetor. Adjust or replace (par. 102).

b. Carburetor Air Cleaner. Service or replace (par. 107).

c. Compression Test. Perform (par. 86).

d. Crankcase Ventilator Control Valves. Replace (par. 93).

e. Cylinder Head Gasket. Replace (par. 91).

f. Distributor and Ignition Coil Assembly. Adjust or replace (par. 113).

g. Distributor Capacitor. Replace (par. 113).

h. Drive Belts. Adjust or replace (par. 124).

i. Exhaust Manifold. Replace (par. 88).

j. Exhaust Manifold Gasket. Replace (par. 88).

k. Fan. Replace (par. 123).

l. Fuel Lines and Connections. Replace (par. 106).

m. Fuel Pump. Test (par. 66) or replace (par. 104).

n. Generator. Replace (par. 118).

o. Generator Regulator. Replace (par. 119).

p. Ignition Coil. Replace (par. 113).

q. Ignition Points. Adjust or replace (par. 113).

r. Ignition Timing. Adjust (par. 112).
s. Ignition Wiring. Replace (par. 114).
t. Oil Filter. Replace (par. 90).
u. Oil Filter Element. Replace (par. 90).
v. Oil Pan. Replace (par. 89).
w. Radiator. Service or replace (pars. 121 and 122).
x. Radiator Hose. Replace (par. 122).
y. Spark Plugs. Adjust or replace (par. 114).
z. Spark Plug Cables. Replace (par. 114).
aa. Starter. Replace (par. 116).
ab. Thermostat. Replace (par. 125).
ac. Valves. Adjust (par. 92).
ad. Water Pump. Replace (par. 123).

88. Exhaust Manifold

a. Removal.

(1) *Remove ventilator control cable* (fig. 33). Loosen set screws securing ventilator control cable to lower crankcase ventilator control valve and control cable bracket. Pull ventilator control cable out of pivot on crankcase ventilator control valve and lay ventilator control cable to one side.

(2) *Remove control cable bracket and windshield wiper vacuum line.* Remove safety nut and lock washer attaching control cable bracket (fig. 33) to cylinder block and remove control cable bracket. Unclip windshield wiper vacuum line (fig. 22) from clip on exhaust valve cover and push vacuum line down below level of exhaust manifold to exhaust pipe flange.

(3) *Disconnect exhaust manifold from exhaust pipe.* Remove safety nut from forward end of exhaust manifold to exhaust pipe flange. Remove safety nut from bolt on rear end of exhaust manifold to exhaust pipe flange and remove bolt.

(4) *Remove exhaust manifold and exhaust manifold gaskets* (fig. 22). Remove five safety nuts from mounting studs attaching exhaust manifold to cylinder block and remove exhaust manifold. When removing exhaust manifold, pull out to disengage exhaust manifold from mounting studs on cyinder block and then up to disengage exhaust pipe from connecting stud on exhaust manifold. Remove three (front, intermediate, and rear) exhaust manifold gaskets from exhaust ports and discard. Remove exhaust manifold gasket between flange of exhaust manifold and exhaust pipe.

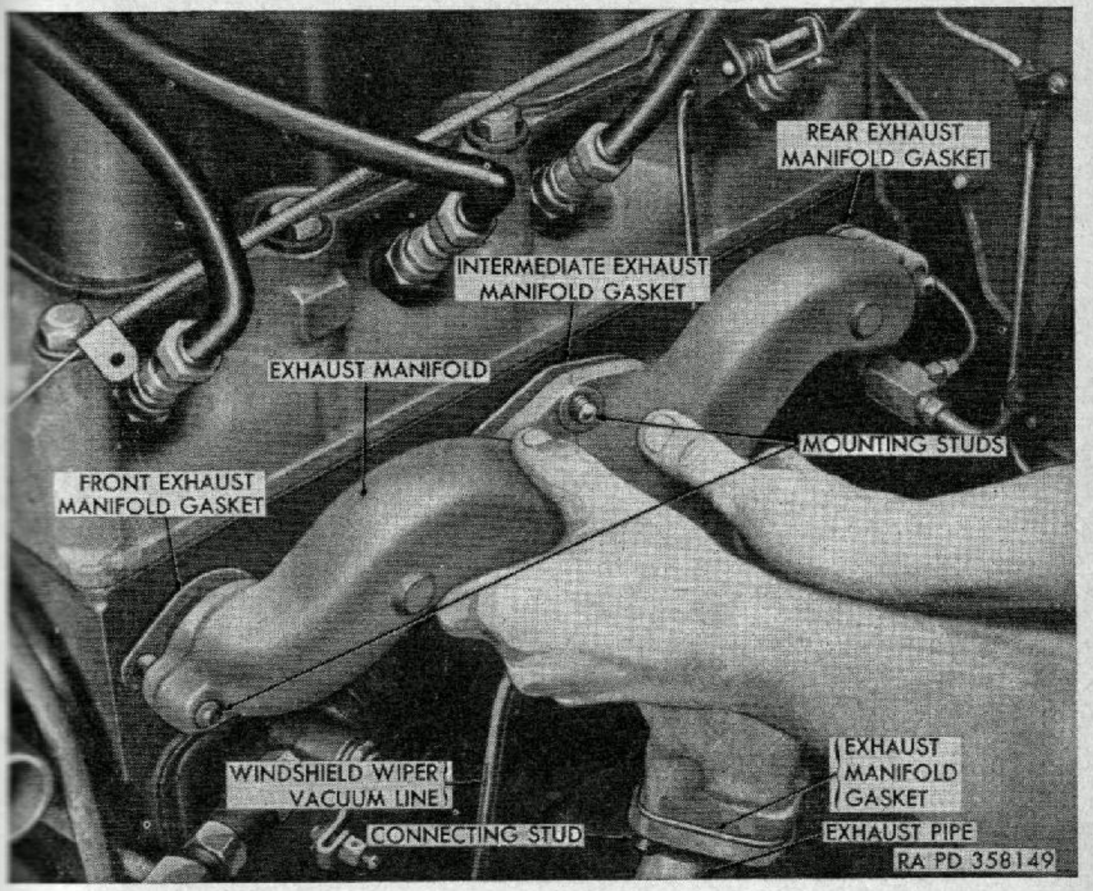


Figure 22. Removing exhaust manifold.

b. Installation.

(1) *Inspect exhaust manifold and clean gasket surfaces.* Inspect exhaust manifold for evidence of cracks or warpage. Clean all deposits of old exhaust manifold gaskets from gasket surfaces of exhaust manifold and cylinder block.

(2) *Install exhaust manifold gaskets* (fig. 22). Install front, rear, and intermediate exhaust manifold gaskets in exhaust ports with metal portions of front and rear exhaust manifold gaskets inserted into exhaust ports. Place a new exhaust manifold gasket between flanges of exhaust manifold and exhaust pipe.

(3) *Install exhaust manifold* (fig. 22). Position connecting stud on exhaust manifold in hole in flange on exhaust pipe. Push down on exhaust manifold and install exhaust manifold on mounting studs. Make sure mounting studs enter holes in exhaust manifold as evenly as possible to avoid damaging threads.

(4) *Attach exhaust manifold* (fig. 22) *to cylinder block and exhaust pipe.* Install the bolt at the rear end of the exhaust manifold to exhaust pipe flange. Insert the bolt from the top and install safety nut. Install safety nut on connecting

stud but do not tighten. Install 5 exhaust manifold safety nuts on mounting studs and tighten evenly to 45 to 55 pound-feet torque with a torque indicating wrench. Tighten safety nuts at exhaust manifold to exhaust pipe flange to 45 to 55 pound-feet torque.

(5) *Install control cable bracket and windshield wiper vacuum line.* Pull windshield wiper vacuum line (fig. 22) up into position and install in clip on exhaust valve cover. Position control cable bracket (fig. 33) on cylinder block and secure with safety nut.

(6) *Install ventilator control cable* (fig. 33). Insert crankcase ventilator control cable in pivot on crankcase ventilator control valve and tighten set screw. Place clip attached to ventilator control cable on control cable bracket. Install screw and nut and tighten securely.

(7) *Test installation.* Start and run engine to check for leaks around exhaust manifold connections.

89. Engine Oil Pan

a. Removal.

(1) Drain engine oil by removing drain plug (fig. 43). Replace drain plug when oil has drained completely.

(2) Remove crankshaft pulley shield (fig. 43) by removing six cap screws and lock washers.

Note.—Do not lose the six spacers over each cap screw between the crankshaft pulley shield and the engine oil pan.

(3) Remove the 14 remaining cap screws and lock washers securing the engine oil pan and remove the engine oil pan and oil pan gasket. Discard oil pan gasket.

b. Installation.

(1) Clean engine oil pan thoroughly and clean gasket surfaces of engine oil pan and cylinder block of all particles of old gasket material. Cement a new oil pan gasket to the flange of the engine oil pan, lining up the holes carefully.

Note.—Always use a new oil pan gasket whenever the engine oil pan is removed.

(2) Place engine oil pan in position against the cylinder block and install 14 cap screws and lock washers.

Note.—Do not install cap screws and lock washers in the six holes at the front of the engine oil pan.

(3) Position crankshaft pulley shield (fig. 43) with spacers between shield and engine oil pan, and install six cap screws

with lock washers. Tighten all cap screws evenly to 10 to 14 pound-feet torque. Remove cover of oil filler pipe (fig. 23) and fill with proper lubricant (par. 53).

90. Engine Oil Filter

a. *Servicing.*

(1) *Cuno type.* Servicing of this type engine oil filter consists of turning the handle at the top of the filter assembly and then removing the drain plug at the bottom to drain.

(2) *Replaceable element type.* Servicing of this engine oil filter (fig. 23) consists of replacing the oil filter element (fig. 24) with a new one at scheduled lubrication periods (par. 53). Place a container under the engine oil filter, remove the drain plug (fig. 23), and allow oil to drain. Install drain plug when oil has drained. Unscrew cover bolt (fig. 23) and remove oil filter cover (fig. 23), gasket, and spring. Wipe surface of oil filter element, grasp handle on oil filter and remove oil filter element (fig. 24) from engine oil filter, and discard element. Wipe old oil and sediment from inside of oil filter. Install new oil filter element making certain it seats properly in engine oil filter. Install oil filter cover with spring and gasket and secure with cover bolt (fig. 23).

b. *Removal.*

(1) *Cuno type.*

(*a*) Disconnect inlet and outlet lines leading to engine oil filter.

(*b*) Loosen clamping bolt and nut attaching engine oil filter to mounting bracket and lift out engine oil filter.

(2) *Replaceable element type.*

(*a*) Disconnect inlet oil line (fig. 23) and outlet oil line from fittings on the engine oil filter.

(*b*) Loosen mounting nuts and bolts securing mounting clamps around engine oil filter and lift engine oil filter out of mounting clamps.

Note.—If replacement engine oil filter is not supplied with inlet and outlet oil line connections, remove the connections from the old engine oil filter and install them in the new unit.

c. *Installation.*

(1) *Cuno type.*

(*a*) Position engine oil filter in mounting bracket and tighten clamping bolt and nut.

(*b*) Connect inlet and outlet oil lines to engine oil filter.

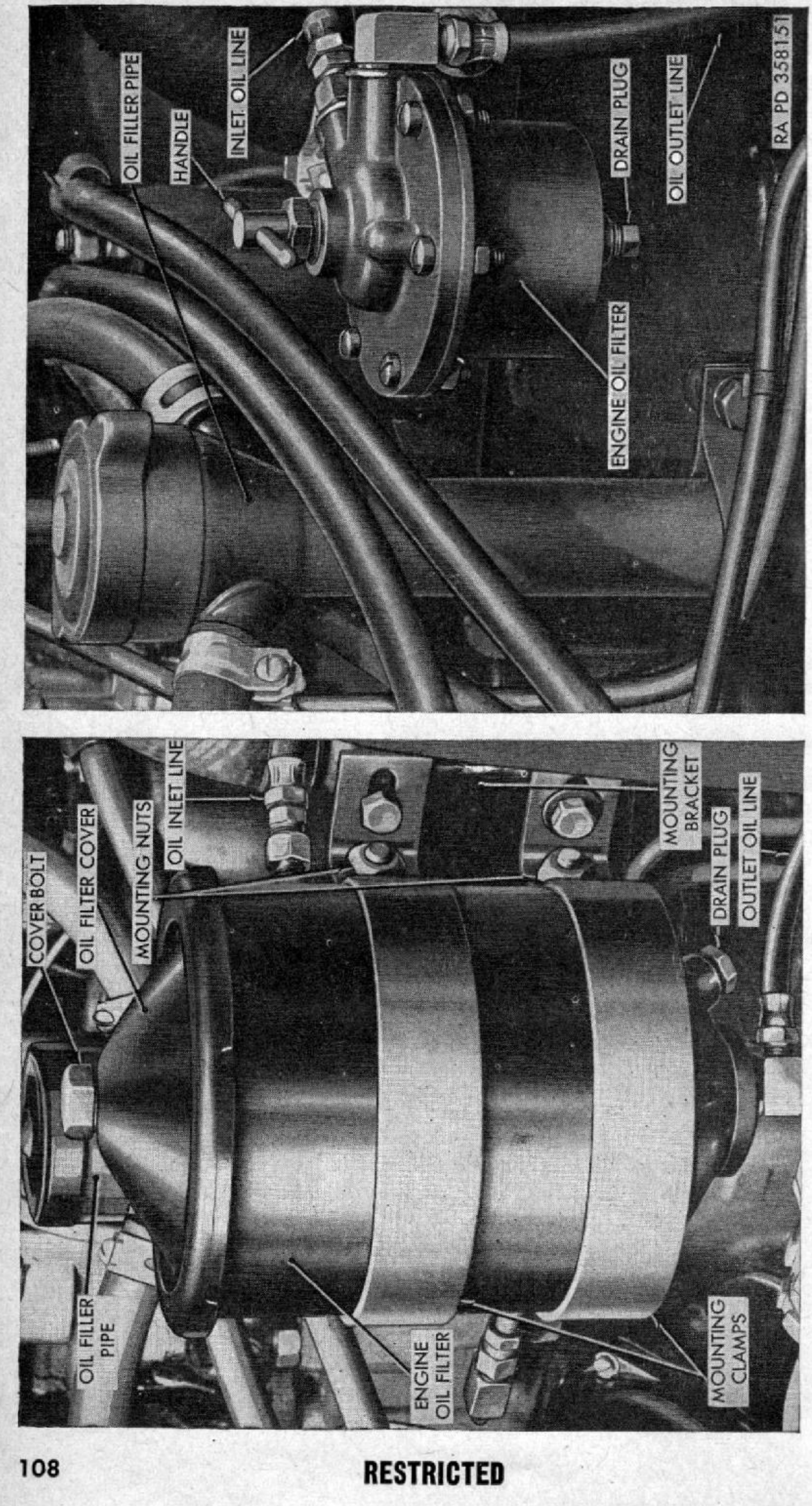


Figure 23. Engine oil filter installed.

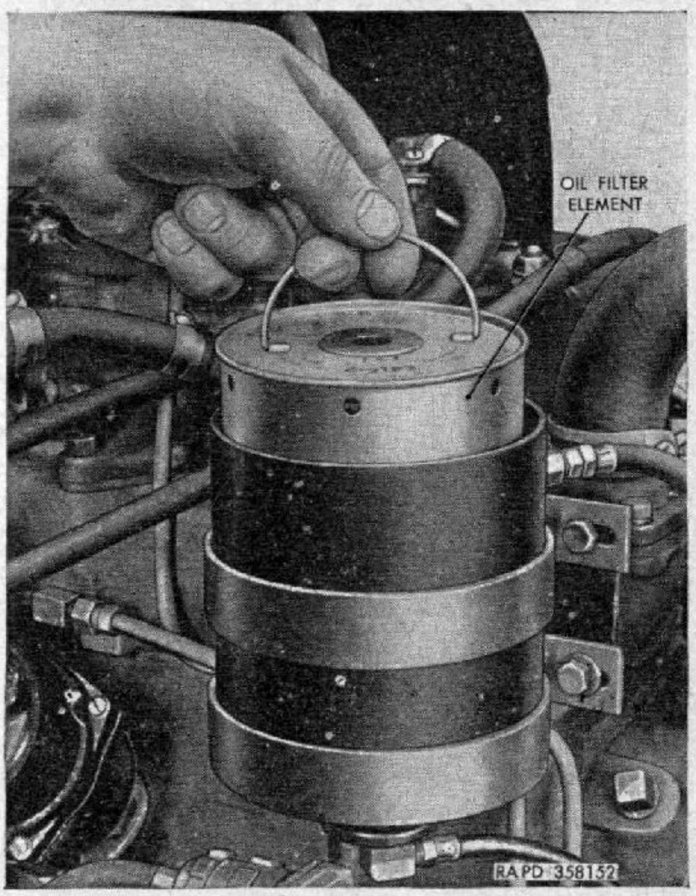


Figure 24. Removing oil filter element.

(2) *Replacement element type.*

(*a*) Place engine oil filter (fig. 23) in mounting clamps and position engine oil filter in clamps so that oil line connections can be easily connected to the inlet and outlet oil lines. Tighten mounting nuts and bolts to secure engine oil filter.

(*b*) Connect inlet oil line near top of engine oil filter and outlet oil line at bottom of engine oil filter.

(*c*) Start and run engine to check for oil leaks at engine oil filter and oil line connections.

91. Cylinder-Head Gasket Replacement

a. Removal.

(1) *Disconnect water hoses.* Drain cooling system (par. 121). Loosen hose clamp (fig. 71) securing water outlet hose to radiator. Remove three cap screws and lock washers securing water outlet elbow to cylinder block and remove water outlet elbow and gasket with water outlet hose attached. Remove thermostat from cylinder head. Loosen hose clamp securing water pump bypass hose to cylinder block and pull bypass hose from fitting on cylinder head.

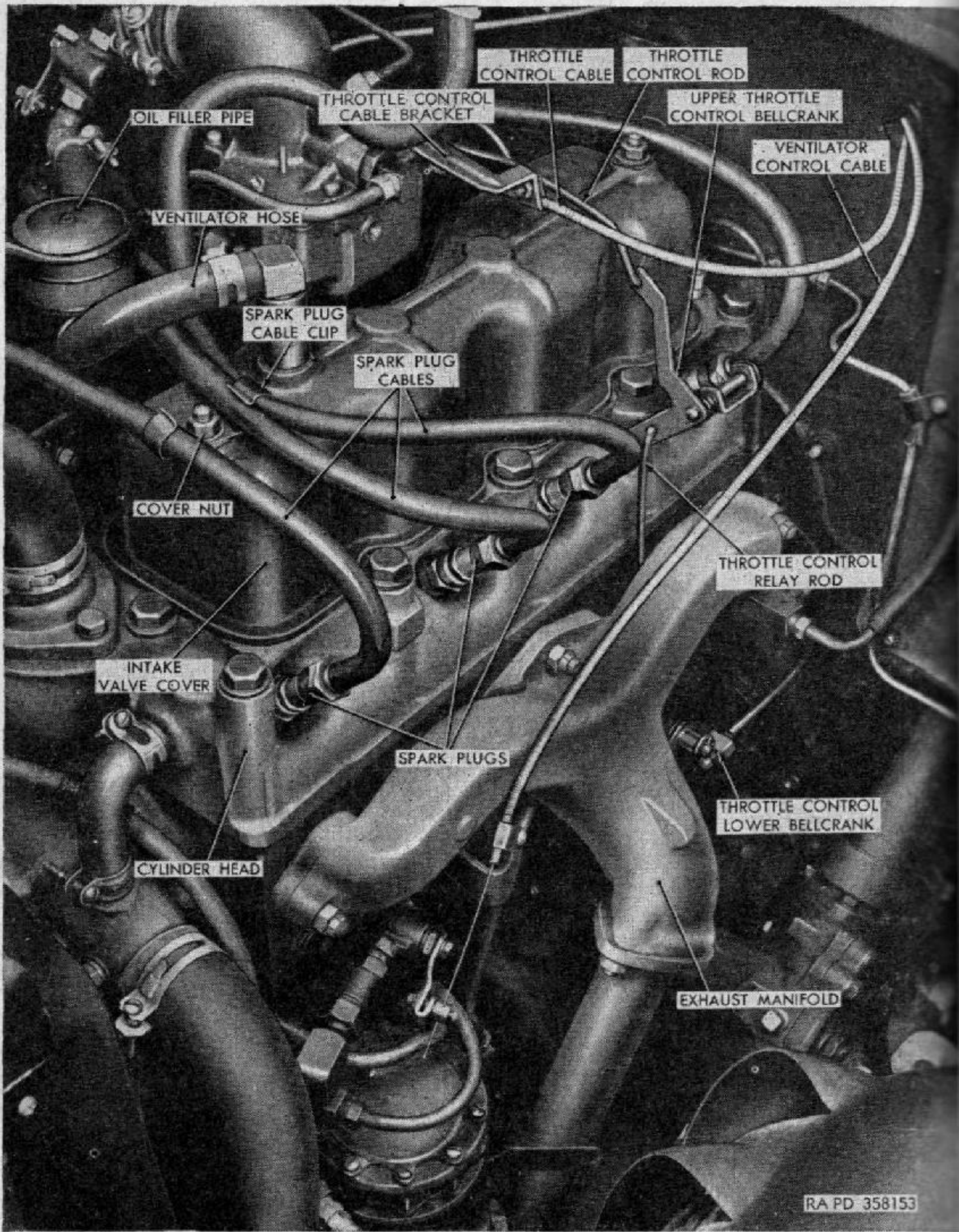


Figure 25. Cylinder head installed on engine.

(2) *Remove spark plug cables and ventilator hoses* (fig. 25). Re- move spark plug cables from spark plugs (par. 114) and pull spark cables from clips on intake valve cover. Loosen hose clamps securing ventilator hoses to both fittings on oil filler pipe and pull ventilator hoses from fittings.

(3) *Remove control cables.* Remove cotter pin and disconnect throttle control rod (fig. 25) from throttle lever. Loosen set screw and remove cable stop (fig. 48) from throttle control cable (fig. 48). Remove two screws and lock washers attach-

ing throttle control cable bracket (fig. 25) to carburetor and swing throttle control cable and throttle control rod out of way. Loosen set screw securing choke control cable (fig. 32) to carburetor and swing cable out of way. Disconnect ventilator control cable (fig. 25) from upper crankcase ventilator control valve (fig. 32) and control cable bracket (fig. 32) on air intake pipe and lay ventilator control cable to one side.

(4) *Disconnect sending unit and oil line.* Disconnect the valve rocker arm oil supply line (fig. 26) from rear of cylinder block and swing oil supply line to one side. Disconnect cable at connector from engine temperature gage sending unit (fig. 27).

(5) *Remove intake valve cover.* Remove cover nuts (fig. 25) securing intake valve cover (fig. 25) to cylinder head. Lift spark plug cable clips (fig. 25), flat washers and seals off spacer studs, and remove intake valve cover (fig. 26) by lifting it up and off spacer studs (fig. 27). Remove cover gasket (fig. 26) and discard.

(6) *Remove carburetor.* Remove carburetor as outlined in paragraph 102.

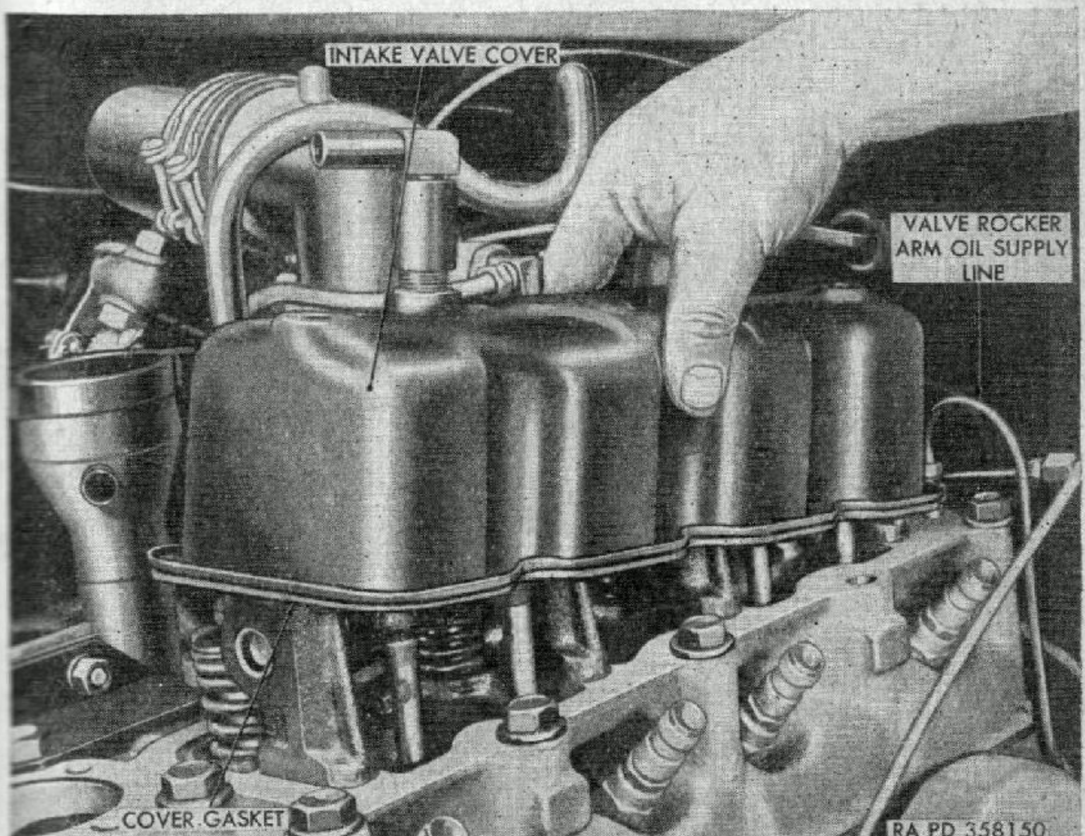


Figure 26. Removing intake valve cover.

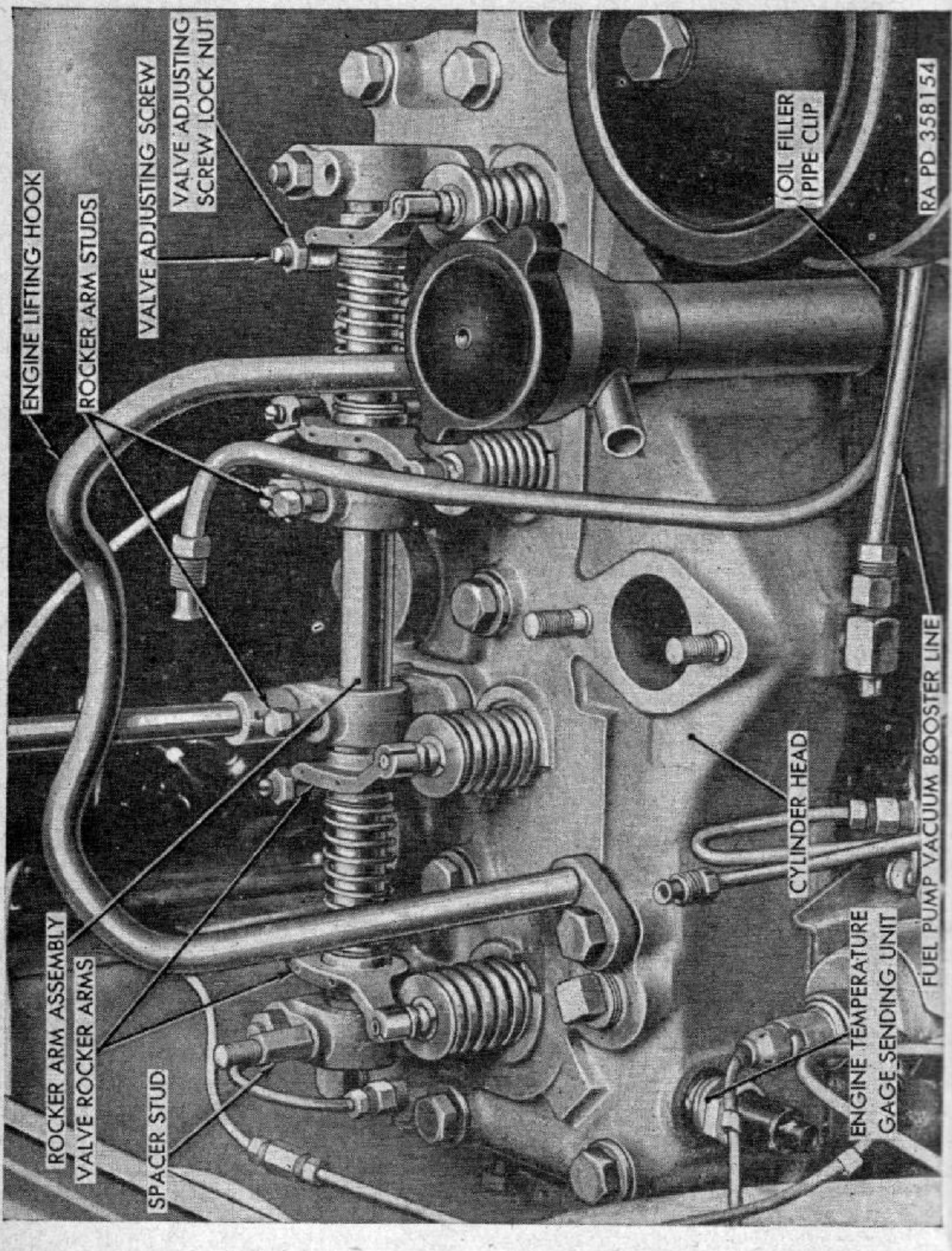


Figure 27. Cylinder head and valve rocker arms with intake valve cover removed.

(7) *Remove rocker arm assembly.* Remove spacer studs (fig. 27) from each end of rocker arm assembly. Remove four nuts securing rocker arm assembly to rocker arm studs (fig. 27). Grasp rocker arm assembly securely at each end to prevent it from springing apart and lift rocker arm assembly off rocker arm studs. Remove four intake valve push rods from cylinder head.

(8) *Remove cylinder head* (fig. 27). Disconnect fuel pump vacuum booster line from fitting on right side of cylinder head. Remove cap screw and flat washer securing oil filter pipe clip and oil filter bracket to right side of cylinder head. Remove the two cylinder head cap screws and flat washers securing the front part of the engine lifting hook and oil filter bracket and lay oil filter bracket with engine oil filter attached to one side. Remove the remaining 13 cylinder head cap screws and flat washers and the engine lifting hook.

Note.—One cylinder head cap screw (fig. 28) is located down in the intake manifold.

Lift off the cylinder head and cylinder head gasket and discard cylinder head gasket.

b. *Installation.*

(1) *Clean cylinder head and cylinder block.* Clean gasket deposits and carbon deposits from both cylinder head and cylinder block.

(2) *Install cylinder head gasket and cylinder head.* Position a new cylinder head gasket on the cylinder head being careful to place it correctly over the valves and holes in the cylinder block. Carefully lower the cylinder head onto the cylinder head gasket and cylinder block. Insert one cylinder head cap screw at each end of the cylinder head to properly aline cylinder head with cylinder head gasket and cylinder block.

(3) *Install cylinder head cap screws.* Install oil filter bracket on cylinder block in alinement with first two holes on right side and install and tighten the front cylinder head cap screw and flat washer. Place the engine lifting hook (fig. 27) over the rear hole in the oil filter bracket and install and tighten cylinder head cap screw with flat washer. Install cylinder head cap screw and flat washer securing the rear part of engine lifting hook and tighten.

Note.—The loop of the engine lifting hook (fig. 27) must be pointing in toward the center of the cylinder head.

Install cylinder head cap screw and flat washer securing the upper throttle control bellcrank (fig. 25) and tighten. In-

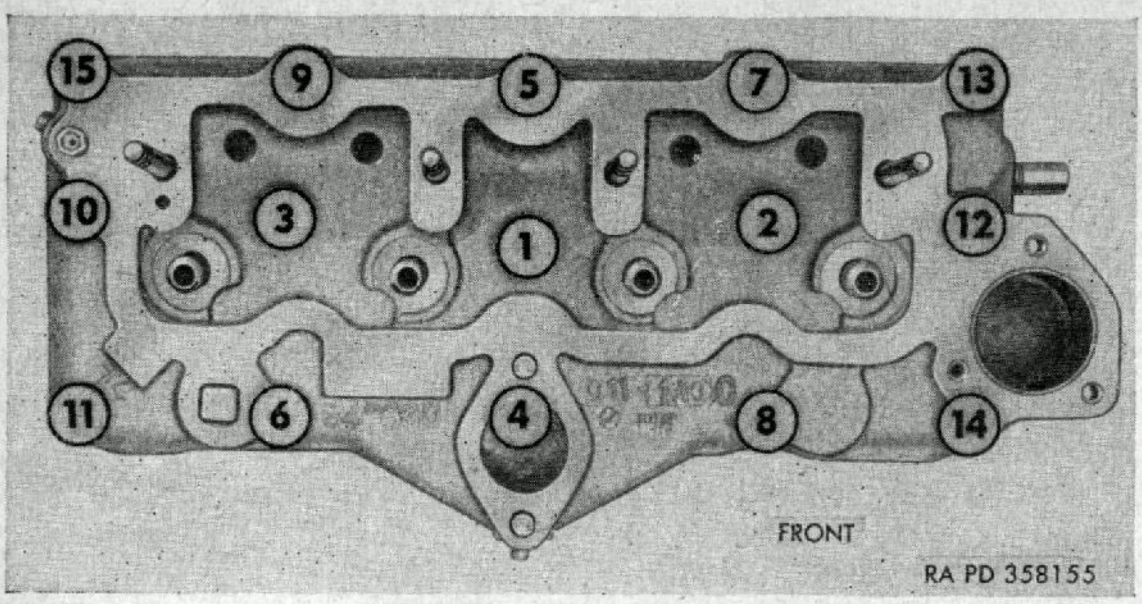


Figure 28. Cylinder head cap screws tightening sequence.

stall the remaining 12 cylinder head cap screws and flat washers and tighten all cylinder head cap screws to 65 to 75 pound-feet torque with a torque indicating wrench in sequence indicated in figure 28.

(4) *Install oil pipe clip and oil lines.* Connect valve rocker arm oil supply line (fig. 26) to fitting at the rear of cylinder head. Connect fuel pump vacuum booster line (fig. 27) to fitting on right side of cylinder head. Install cap screw and lock washer securing oil filler pipe clip (fig. 27) and oil filter bracket to cylinder head.

(5) *Install carburetor.* Install carburetor as outlined in paragraph 102.

(6) *Install rocker arm assembly.* Install four intake valve push rods in cylinder head. Install rocker arm assembly over rocker arm studs and seat rocker arm assembly on cylinder head.

Note.—Make certain intake valve push rods are correctly installed in sockets of each rocker arm.

Install four nuts securing rocker arm assembly to rocker arm studs and tighten securely. Install spacer studs (fig. 27) at each end of rocker arm assembly. Adjust intake valves (par. 92*a*).

(7) *Install intake valve cover* (fig. 25). Install intake valve cover with a new cover gasket over spacer studs. Install seals, flat washer, and spark plug cable clips over spacer studs and secure with two cover nuts.

(8) *Connect sending unit.* Connect cable to engine temperature gage sending unit (fig. 27).

(9) *Connect control cables.* Insert ventilator control cable (fig. 32) in pivot on upper crankcase ventilator control valve and tighten set screw. Secure ventilator control cable to control cable bracket with screw and nut. Connect choke control cable to carburetor and tighten screws securely. Insert throttle control rod (fig. 25) in throttle lever and install cotter pin. Insert throttle control cable in pivot on throttle lever and install cable stop, securing it with set screw. Position control cable bracket on carburetor and secure with two screws and lock washer.

(10) *Install spark plug cables and ventilator hose* (fig. 25). Install ventilator hose on fitting on oil filler pipe and tighten hose clamps. Insert spark plug cables in spark plug cable clips on intake valve cover and secure cables to spark plugs.

(11) *Install water hoses.* Place thermostat in cylinder head and install water outlet elbow (fig. 71) and gasket with water outlet hose attached over thermostat, securing the water outlet elbow with three cap screws and lock washers. Install water outlet elbow on radiator and tighten hose clamp. Install water pump bypass hose on fitting on cylinder head and secure with hose clamp. Fill cooling system (par. 121).

(12) *Test installation.* Start and warm up engine to test for leaks and proper operation.

92. Valve-Clearance Adjustment

a. Intake Valves.

(1) *Remove intake valve cover.* Perform operations in paragraph 91*a* (2), (3), and (5) to remove intake valve cover. Install spark plug cables on spark plugs.

(2) *Check and adjust intake valve clearance* (fig. 29). Start engine and allow to run until minimum operating temperature (160° F.) is reached. With engine running at idling speed, insert feeler gage between valve stem cap and rocker arm (fig. 29) to check valve clearance. Using a wrench and screw driver, loosen valve adjusting screw lock nut (fig. 27) and tighten or loosen valve adjusting screw (fig. 27) until proper clearance is measured with the feeler gage. When adjustment is correct, tighten valve adjusting screw lock nut. Repeat this procedure for each intake valve. Set all intake valves to 0.018 inch with slight drag on feeler gage. When all valves are adjusted, check clearance again to make certain tightening of valve adjusting screw lock nut did not disturb adjustment.

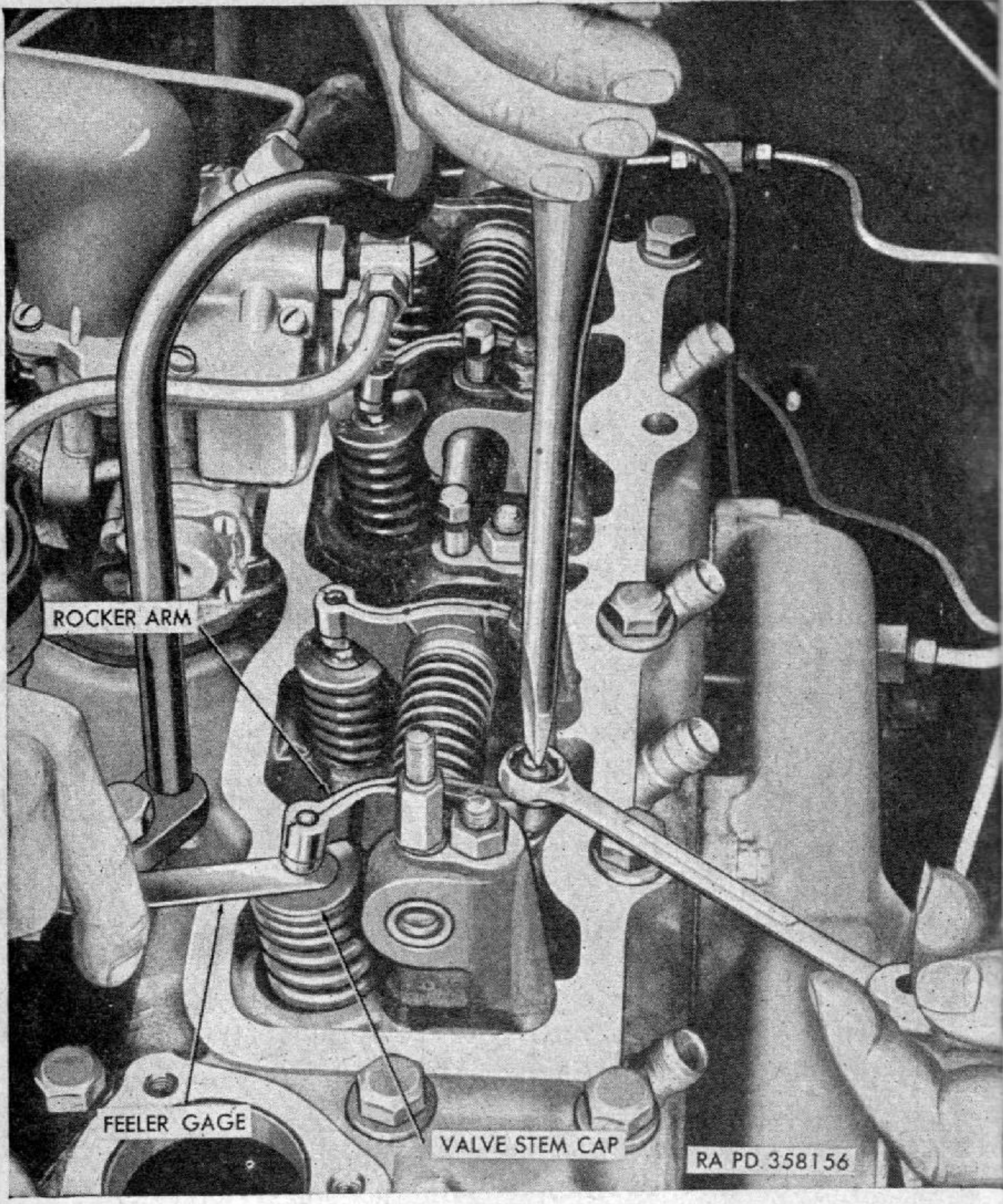


Figure 29. Method of adjusting intake valve clearance.

(3) *Install intake valve cover.* Stop engine. Perform operations paragraph 91*b* (7) and (9) to install intake valve cover.

b. Exhaust Valves.

(1) *Remove exhaust valve cover.* Disconnect ventilator control cable (fig. 33) from lower crankcase ventilator control valve. Disconnect fuel pump vacuum booster lines from elbow on ventilator valve. Remove cover screw securing crankcase ventilator and exhaust valve cover and remove crankcase ventilator and crankcase ventilator control valve with attached parts. Unhook accelerator return spring from throttle control lower bellcrank (fig. 25). Remove cotter

pins from each end of throttle control relay rod (fig. 25) and remove throttle control relay rod. Remove cotter pin, flat washer, and throttle control lower bellcrank from cover screw and remove flat washer behind throttle control lower bellcrank. Unclip windshield wiper vacuum line from clip on exhaust valve cover. Remove cover screws securing rear of exhaust valve cover and remove exhaust valve cover and cover gasket and discard cover gasket.

(2) *Check and adjust exhaust valve clearance* (figs. 30 and 31). With a hand crank, turn engine until the valve tappet of No. 1 cylinder is down all the way, not touching the valve.

Note.—At this position the piston will be on its compression stroke and valve closed with the valve tappet on the heel of the camshaft.

Place one wrench on the valve tappet and another wrench on the tappet adjusting screw. Insert feeler gage between the valve and valve tappet and measure clearance. Clearance should be 0.016 inch for all exhaust valves, with a slight drag on the feeler gage. Hold valve tappet from turning and turn tappet adjusting screw either way to obtain correct clearance. Adjust the remainder of the exhaust valves in the same manner, turning the crankshaft each time to get the valve tappet down.

(3) *Install exhaust valve cover.* Position exhaust valve cover and new cover gasket on cylinder block and install rear

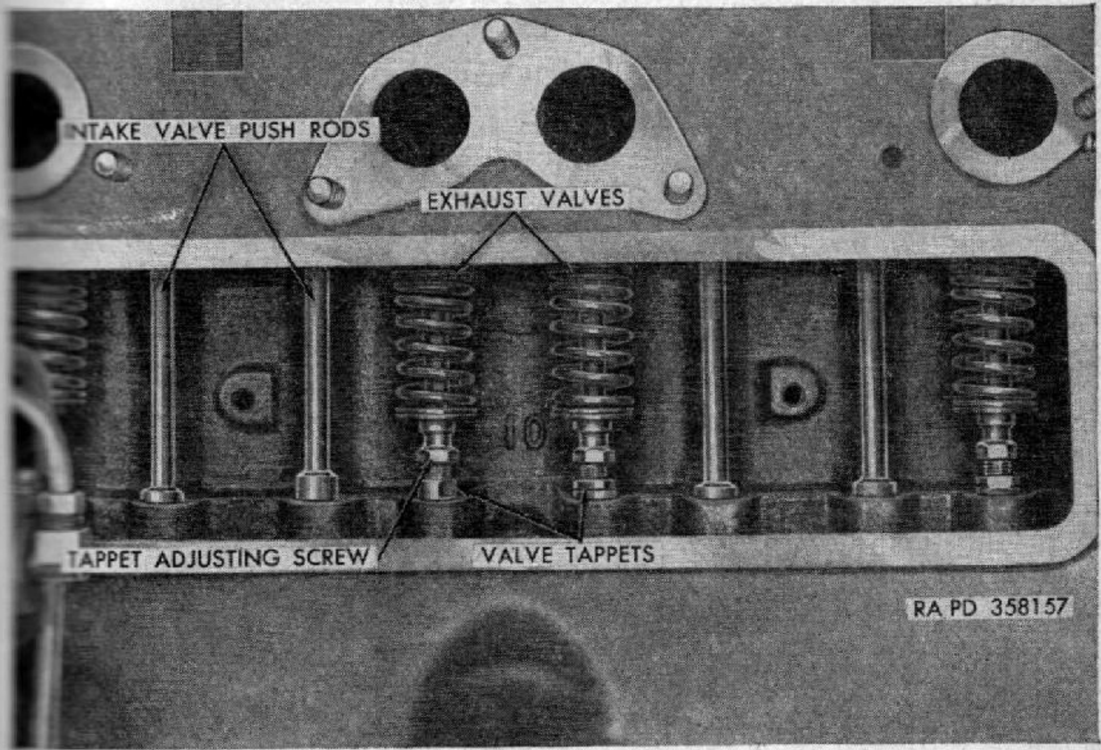


Figure 30. Exhaust valves with exhaust valve cover removed.

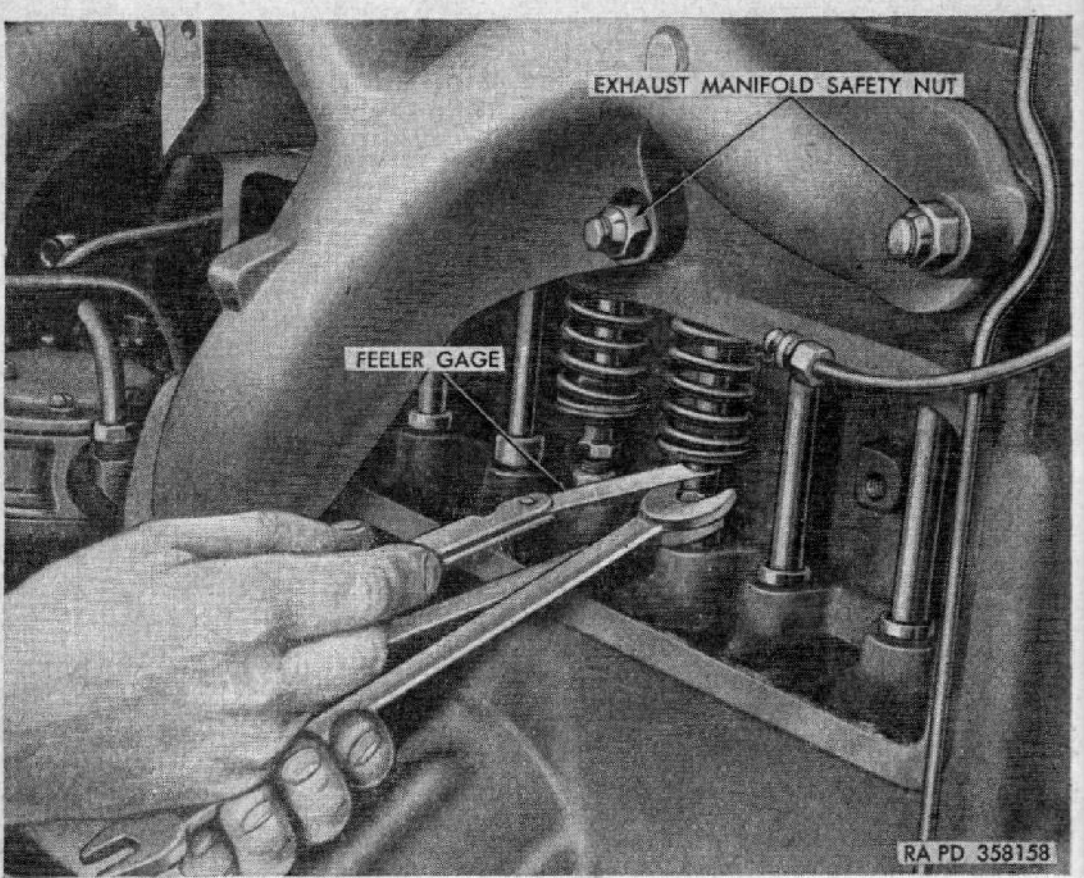


Figure 31. Adjusting exhaust valve clearance.

cover screw, tightening securely. Position crankcase ventilator and lower crankcase ventilator control valve (fig. 33) in position on front of exhaust valve cover and install cover screw. Tighten securely. Connect fuel pump vacuum booster lines (fig. 33) to both sides of elbow on ventilator valve. Place flat washer and throttle control lower bellcrank on rear cover screw and secure with another flat washer and cotter pin. Install throttle control relay rod (fig. 25) on throttle control upper and lower bellcrank and secure with cotter pins at each end of throttle control relay rod. Hook accelerator return spring to throttle control lower bellcrank (fig. 25). Clip windshield wiper vacuum line to clip on exhaust valve cover.

93. Crankcase Ventilator Control Valves

a. Upper Crankcase Ventilator Control Valve (fig. 32).

(1) *Removal.*

(*a*) Loosen set screw in pivot clamping ventilator control cable to ventilator control valve lever. Remove screw and nut attaching ventilator control clip to control cable bracket and swing ventilator control cable out of way.

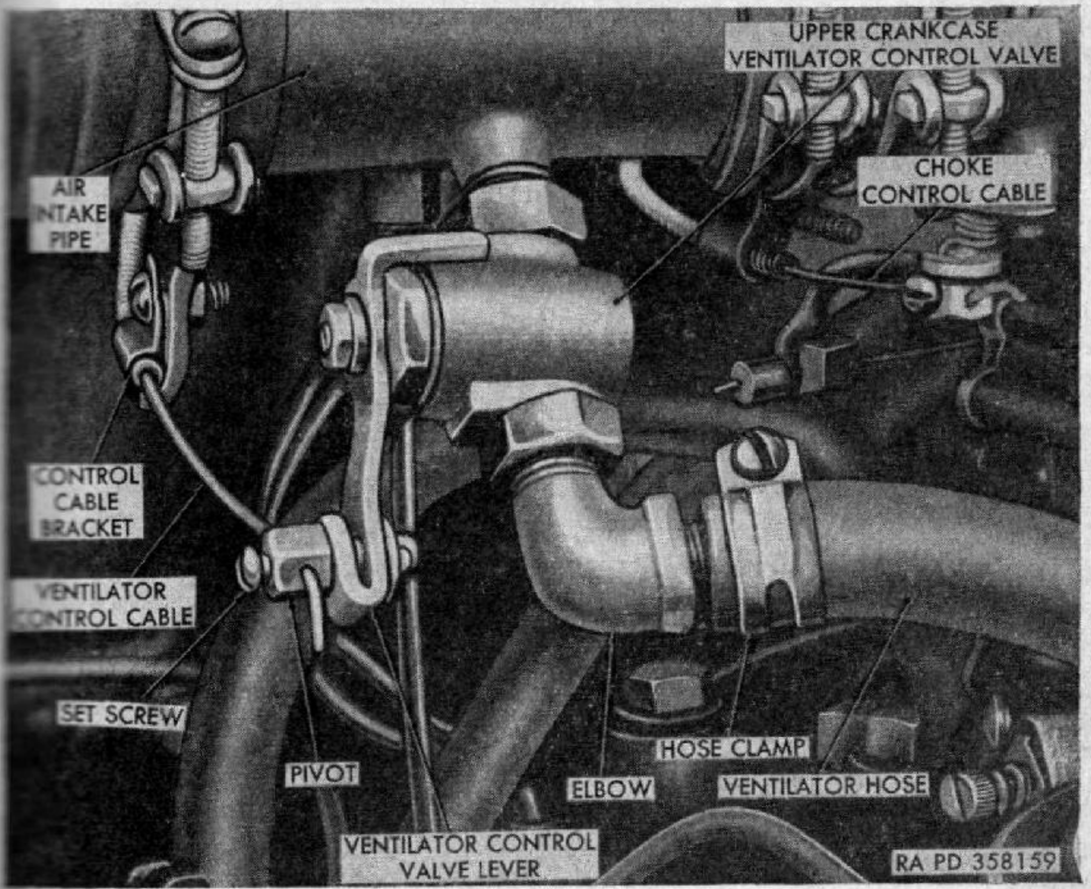


Figure 32. Upper crankcase ventilator control valve installed.

(*b*) Loosen hose clamp and disconnect ventilator hose from elbow attached to crankcase ventilator control valve. Unscrew elbow from crankcase ventilator control valve.

(*c*) Using a suitable wrench, remove crankcase ventilator control valve from fitting on air intake pipe.

(2) *Installation.*

(*a*) Install elbow on end of crankcase ventilator control valve.

(*b*) Install crankcase ventilator control valve on fitting on air intake pipe. Make certain ventilator control valve lever is on the right side to permit installation of the ventilator control cable.

(*c*) Install ventilator hose on elbow and tighten hose clamp securely.

(*d*) Push ventilator control valve lever forward and insert ventilator control cable in pivot, tightening set screw securely. Install ventilator control cable clip on control cable bracket and secure with screw and nut.

b. Lower Crankcase Ventilator Control Valve. (fig. 33)

(1) *Removal.*

(*a*) Loosen set screw in pivot clamping ventilator control cable to ventilator control valve lever. Remove screw and nut attaching ventilator control cable clip to control cable bracket and swing ventilator control cable out of way.

(*b*) Disconnect fuel pump vacuum booster lines from both sides of brass elbow. Unscrew brass elbow from ventilator valve. Remove ventilator valve and crankcase ventilator control valve with connector from elbow attached to crankcase ventilator.

(*c*) Place crankcase ventilator control valve in a vise and remove ventilator valve and connector.

(*d*) If crankcase ventilator is to be removed, remove cover screw and remove crankcase ventilator and gasket. Remove elbow from crankcase ventilator.

(2) *Installation.*

(*a*) If crankcase ventilator was removed, install elbow and attach crankcase ventilator with gasket to exhaust valve cover with cover screw.

(*b*) Install ventilator valve and connector on crankcase ventilator control valve.

(*c*) Install crankcase ventilator control valve with ventilator valve and connector on elbow attached to crankcase venti-

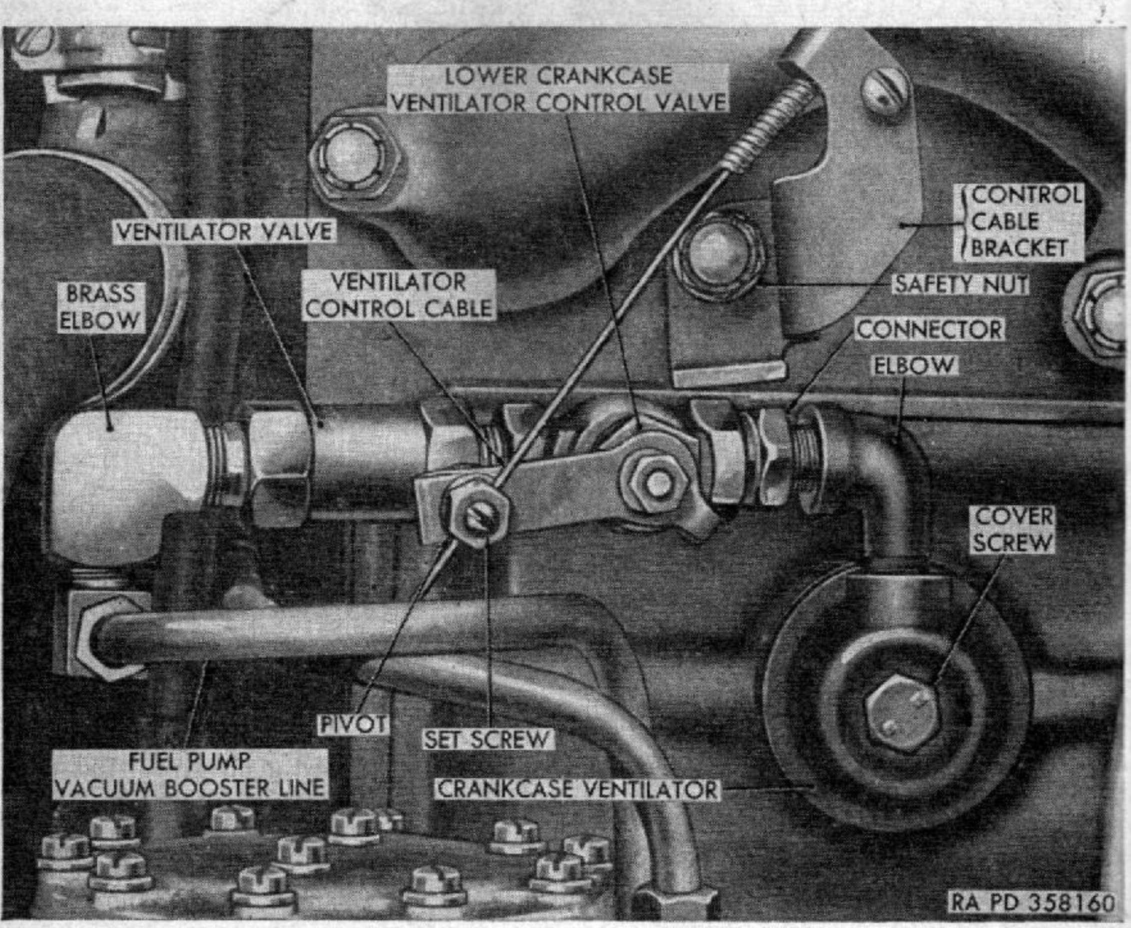


Figure 33. Lower crankcase ventilator control valve and crankcase ventilator installed.

lator. Install brass elbow on ventilator valve and connect fuel pump vacuum booster lines to brass elbow.

(*d*) Insert ventilator control cable in pivot on ventilator control valve lever and tighten set screw. Place ventilator control cable clip on control cable bracket and secure with screw and nut.

Section VI. POWER PLANT REMOVAL AND INSTALLATION

94. General

a. Description. The power plant (figs. 42 and 43), consisting of the engine, radiator, transmission and transfer, must be removed before replacement of the engine, transmission, clutch, or transfer can be accomplished. The radiator (fig. 43) can be replaced without removal of the engine (par. 99) as can all of the engine accessories. The removal and installation of these accessories will be found in the pertinent sections in this chapter. All disconnect points are accessible with the hood open, and the floor pans removed from the passenger compartment. Some disconnect points must be reached from underneath the vehicle.

b. Equipment. In addition to mechanic's common hand tools, one special tool is needed to accomplish power plant removal. Spanner wrench 41–W–3249–900 (fig. 12) is required to uncouple various connections in the electrical system. An engine lifting hook (fig. 27), attached to the cylinder head, provides the means of lifting the power plant from the vehicle. This engine lifting hook is carefully positioned to balance the engine for removal or installation.

95. Coordination With Ordnance Maintenance Unit

Replacement of the power plant engine, transmission, or transfer with a new or rebuilt unit is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, providing authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation which are not carried by the using organization may be obtained from the supporting ordnance maintenance unit.

96. Power Plant Removal

a. Preliminary. It is not necessary to drain the cooling system, engine oil, or transmission oil when removing the power plant assembly. Unlatch hood from fenders and remove hood (par. 216). Disconnect battery ground cable (fig. 78) from battery, and for safety, remove cable completely from battery box by pulling out of hole in box. Turn the fuel shut-off valve (fig. 44) to the "OFF" position.

b. Operations at Front of Vehicle. Remove two radiator to grille screws (G, fig. 35) on left side and two screws on right side attaching radiator to grille. Disconnect the headlight and blackout marker light cables at the connectors (fig. 34) on the inside of the left fender. Loosen two grille cap screws (M, fig. 41) securing the grille to right front fender from the inside of the engine compartment and one from the outside at the bottom of the fender. Repeat for opposite fender. Pull top of grille away from front fenders and radiator until flat section of hinge pin lines up with slot in hinge and remove grille (fig. 34).

c. Operations at Right Side of Vehicle (fig. 35).

(1) Disconnect battery cable (M), generator cable (N) and auxiliary power cable from the starter switch terminal (L) by removing nut and flat washer. Using spanner wrench 41–W–3249–900 (fig. 70), disconnect generator cable at generator connector (F) and pull cable from socket on generator. Unscrew ignition switch cable (K) from side of distributor. Disconnect cable from engine temperature gage

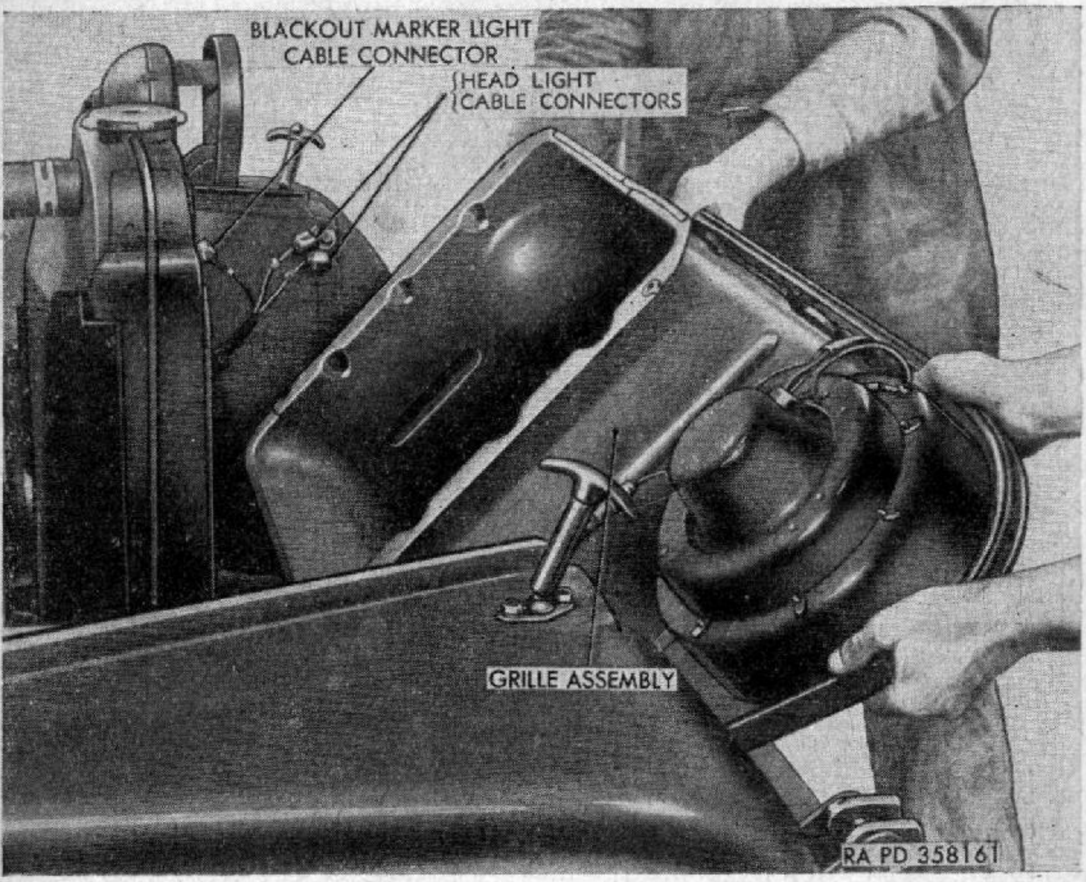


Figure 34. Removing grille.

sending unit (B) and engine oil pressure gage sending unit (C).

(2) Loosen set screws and disconnect control cables from choke lever (E), ventilator control cable (D), and throttle control cable (A, fig. 36). Loosen screws and nuts securing these control cables to their control cable brackets, remove throttle wire stop and swing control cables out of the way.

(3) Loosen hose clamps at both ends of carburetor air intake hose (A) and pull air intake hose from carburetor air cleaner and air intake pipe.

(4) Remove two cap screws (H) and nuts securing front engine support to frame and remove external toothed lock washer from beneath cap screw securing ground strap (J) to rear part of front engine support.

d. Operations at Left Side of Vehicle (fig. 36).

(1) Loosen set screw securing ventilator control cable (B) to lower crankcase ventilator control valve and remove screw and nut securing ventilator control cable to control cable bracket. Swing control cable out of way. Remove two cap screws (G) and lock washers securing front engine support to frame.

(2) Make certain fuel shut-off valve is off and disconnect fuel line at flexible fuel line (F).

(3) Remove safety nut and cap screw connecting exhaust manifold (D) to exhaust pipe (E). Push down on exhaust pipe flange to disconnect exhaust pipe from exhaust manifold and remove exhaust manifold gasket.

(4) Disconnect windshild wiper vacuum line from vacuum tee (C) attached to windshield wiper vacuum line.

(5) Remove cap screw securing the shank of the brake pedal to brake pedal lever (L, fig. 41) and, from the passenger compartment, remove the brake pedal.

(6) Remove cotter pin and washer from throttle block at upper hole in accelerator bellcrank below exhaust manifold. Pull and/or push accelerator pedal and linkage back through toe board.

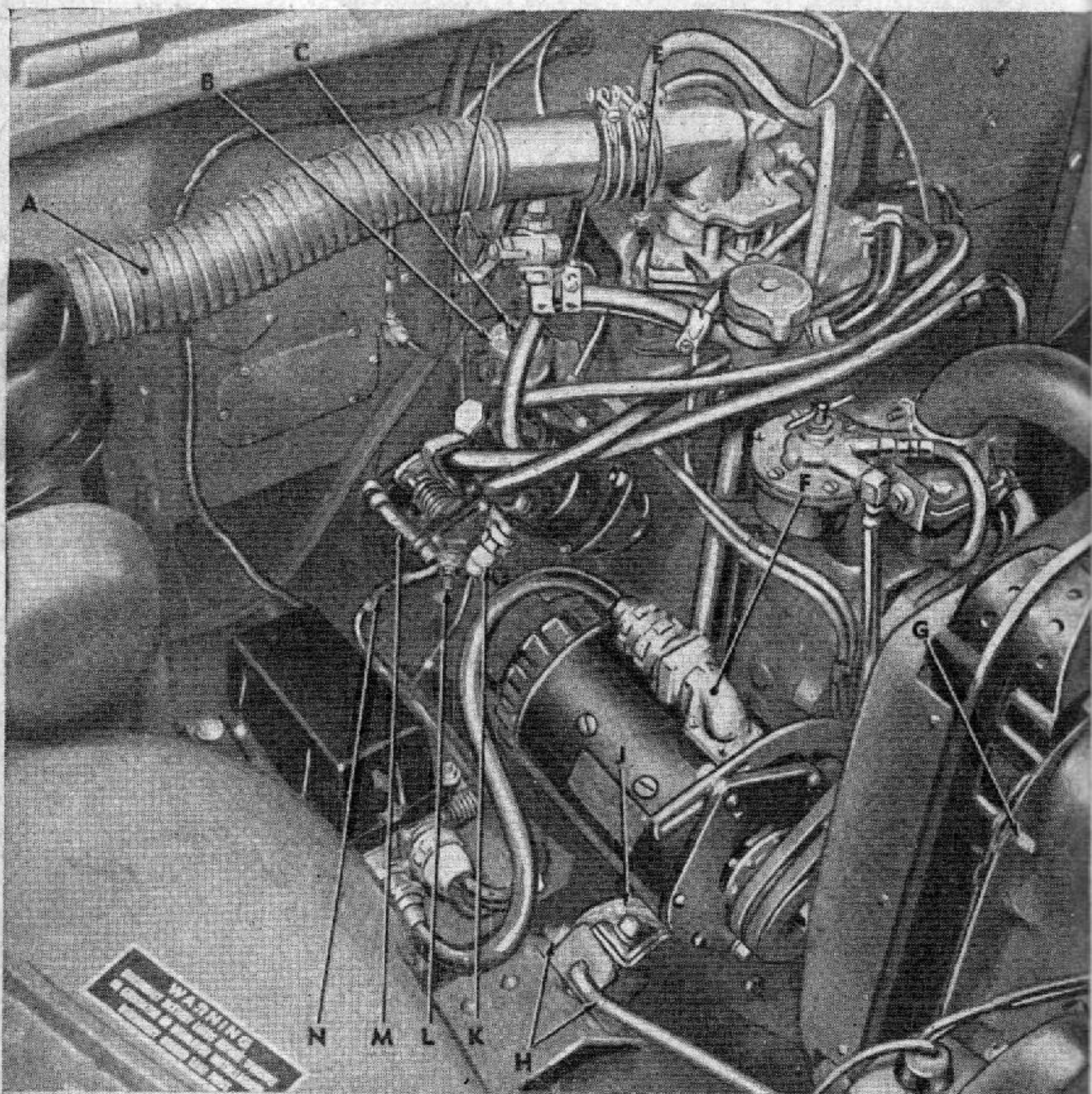
e. Operations Inside Passenger Compartment (fig. 37).

(1) Remove transmission gearshift lever (A) by loosening lower boot clamp (D) and sliding boot clamp up over gearshift lever boot and gearshift lever. Unscrew gearshift lever housing cap and remove gearshift lever by lifting it out of the shifting rail. Stuff a rag in opening in gearshift lever housing to prevent dirt from entering transmission.

(2) Remove transfer shift lever knobs. Remove four cap screws

securing shift lever grommet retaining ring (F) to transmission cover plate and remove grommet retaining ring and grommet over transfer shift levers. Loosen cap screws and swing transfer access plate (G) to one side. Remove shift lever springs with a pair of pliers. Remove lubrication fitting from transfer shift lever pivot pin and remove transfer shift lever pivot pin. Remove transfer shift levers from slots in shifter rails and remove transfer shift levers.

(3) Remove four cap screws securing retainer ring (B) and grommet around steering column, separate halves of retainer



A—AIR INTAKE HOSE
B—ENGINE TEMPERATURE GAGE SENDING UNIT
C—ENGINE OIL PRESSURE GAGE SENDING UNIT
D—VENTILATOR CONTROL CABLE
E—CHOKE LEVER
F—GENERATOR CONNECTOR
G—RADIATOR TO GRILLE SCREWS
H—CAP SCREWS
J—GROUND STRAP
K—IGNITION SWITCH CABLE
L—STARTER SWITCH TERMINAL
M—BATTERY CABLE
N—GENERATOR CABLE

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Figure 35. Disconnect points on right side of vehicle.

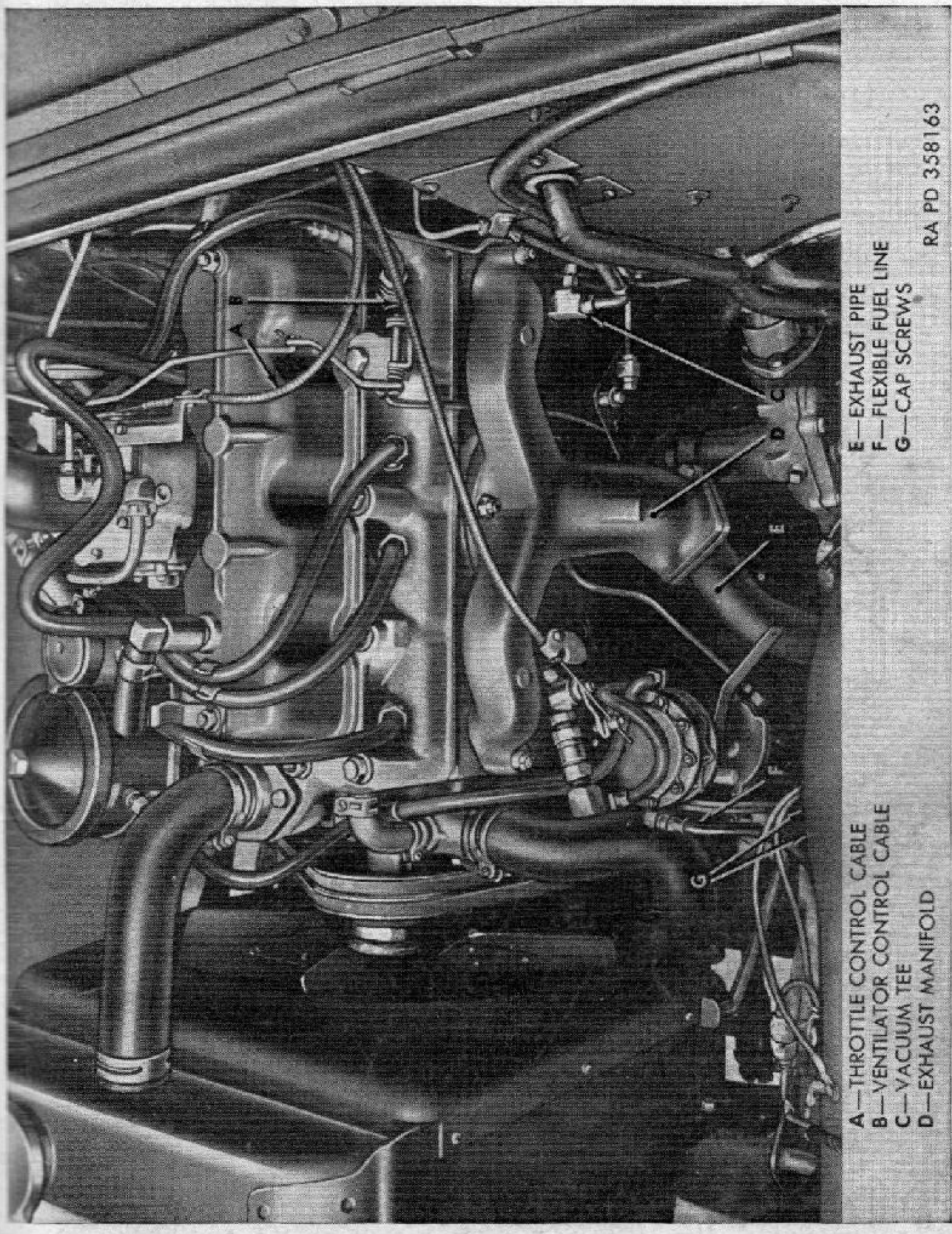


Figure 36. Disconnect points on left side of vehicle.

ring and remove. Remove four cap screws securing brake master cylinder inspection cover (K) to transmission cover plate and remove cover. Remove three caps screws securing floor board extension (C) above steering column and remove toe board extension.

(4) Remove the 10 remaining cap screws securing the toe board cover plate (E) and remove toe board cover plate with starter switch pedal attached. Remove the 11 remaining cap screws securing the transmission cover plate (H) and remove transmission cover plate.

(5) Disconnect rear universal joint of front propeller shaft (A, fig. 38) (par. 167).

(6) Unscrew dust cap on rear propeller shaft (D, fig. 39) to permit sliding yoke to slide from splines on rear propeller shaft when power plant is removed.

(7) Remove mounting nut (B, fig. 38), mounting bolt, flat washer, and lock washer attaching transfer to frame cross member.

(8) Remove two nuts and lock washers securing transmission and transfer support (G, fig. 39) to frame cross member.

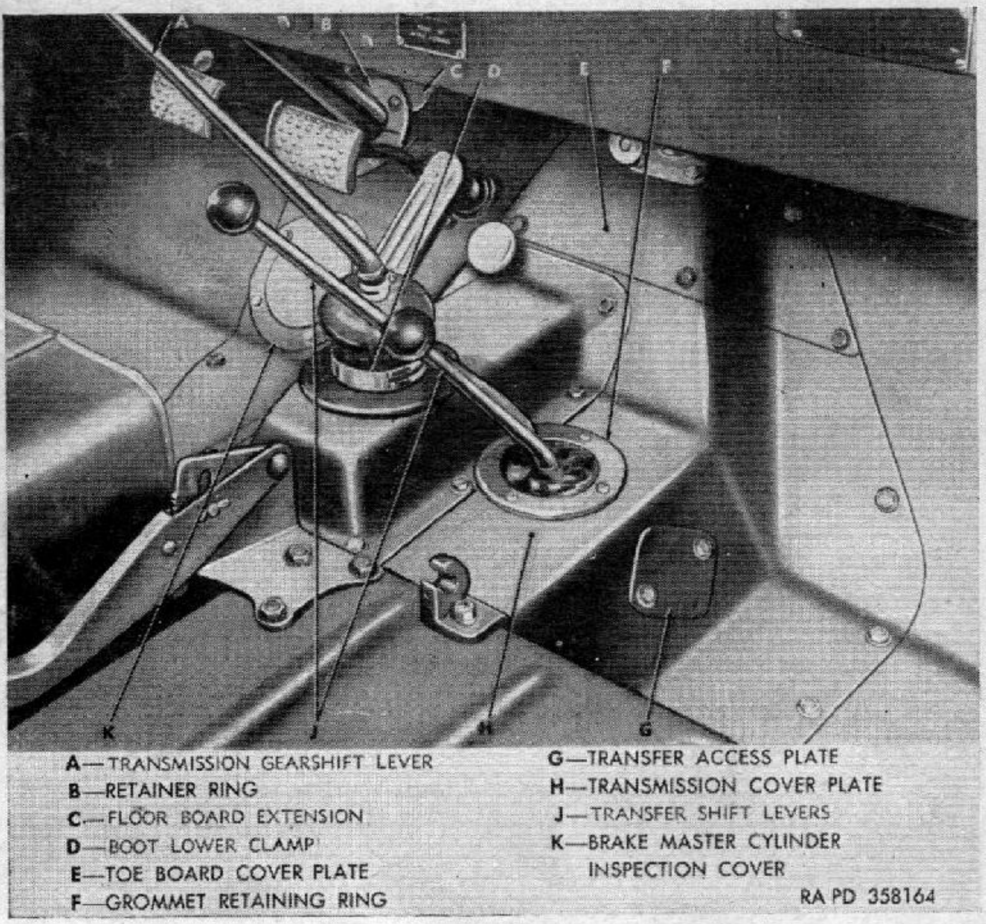
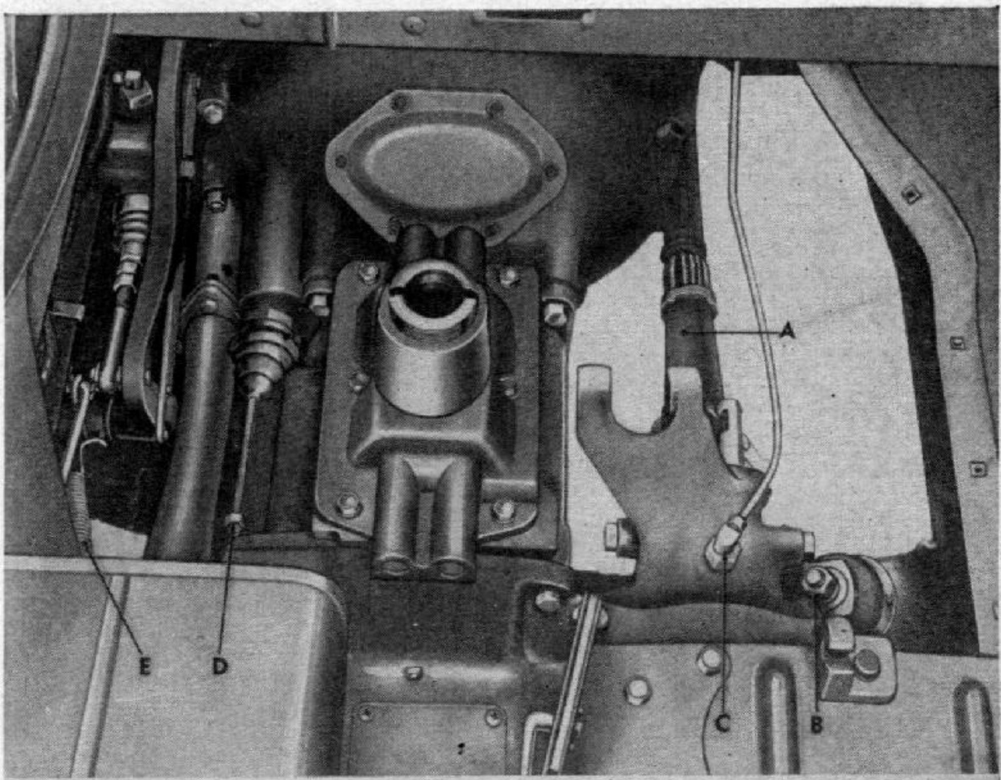


Figure 37. Disconnect points in passenger compartment with cover plates installed.



A—FRONT PROPELLER SHAFT
B—MOUNTING NUT
C—TRANSFER VENT LINE
D—CLUTCH CONTROL CABLE YOKE
E—BRAKE RETURN SPRING
RA PD 358165

Figure 38. Disconnect points in passenger compartment with cover plates removed.

(9) Remove cotter pin and remove clevis pin from clutch control cable yoke (D, fig. 38) to disconnect clutch control cable from clutch and brake pedal cross shaft. Unhook brake return spring (E, fig. 38) from brake lever.

f. Operations Under Vehicle (fig. 39).

(1) Remove engine stay cable by removing stay cable adjusting nut permitting engine stay cable to be disconnected from stay cable bracket (H) on frame cross member and bellhousing.

(2) Remove cotter pin and remove clevis pin from yoke on parking brake control rod (B) and separate parking brake control rod from parking brake lever (C). Tie parking brake lever up as far as it will go to prevent it catching on frame cross member when removing power plant.

(3) Disconnect speedometer cable (E) from transfer rear bearing cap and pull speedometer cable out of speedometer driven gear.

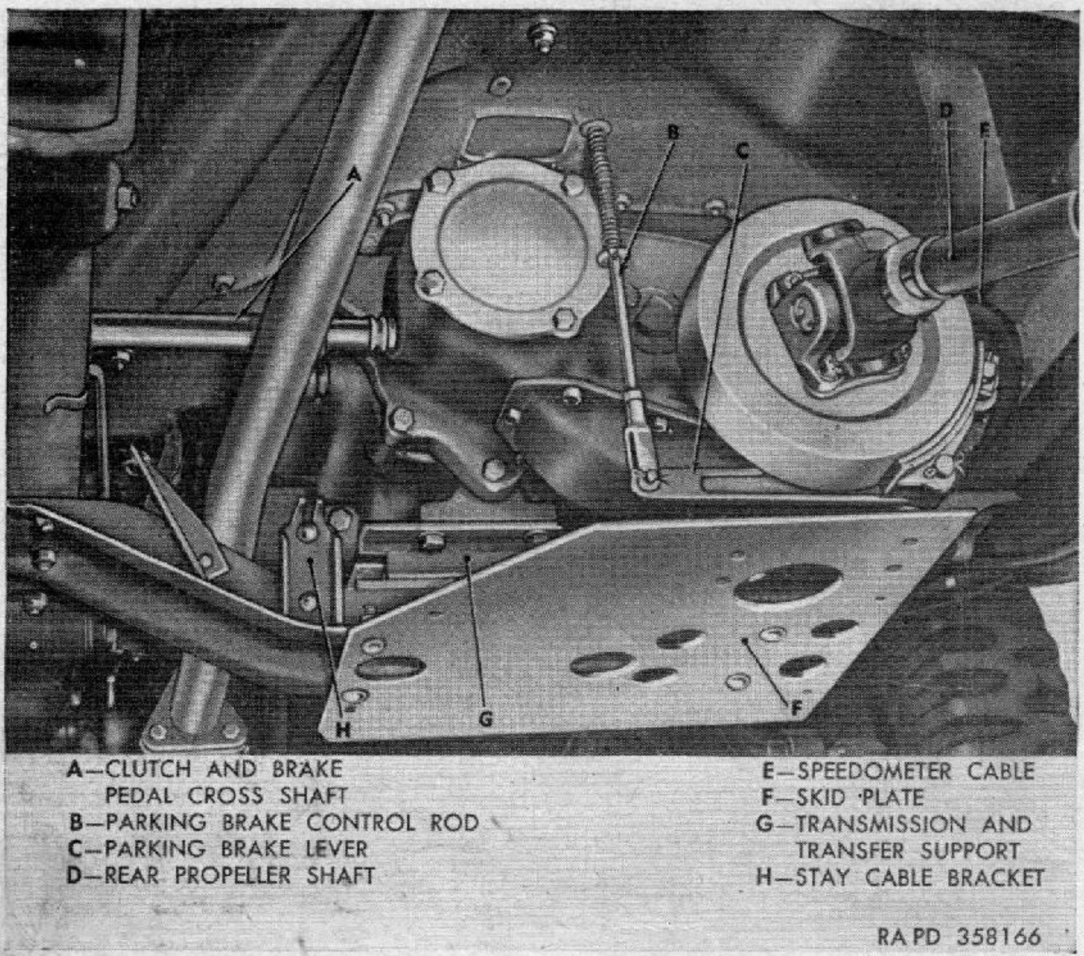


Figure 39. Disconnect points under vehicle.

g. Remove Power Plant From Vehicle (fig. 40).

(1) With a pry-bar, force the rear of the power plant to the right to disconnect clutch and brake pedal cross shaft (A, fig. 39) at the ball stud from the transmission. This also positions slots in transmission and transfer support for removal.

Warning.—Before proceeding with the following operation, be sure radiator, fan and generator drive pulley shield and skid plate edges clear fuel line inside front cross member.

(2) Place chain hoist in rear portion of engine lifting hook and carefully lift power plant up until grooves in front engine supports and slots in transmission and transfer support are clear. By a process of gradually lifting the power plant and rolling the vehicle back, remove the power plant.

(3) Place power plant on stand suitable to permit work to be accomplished.

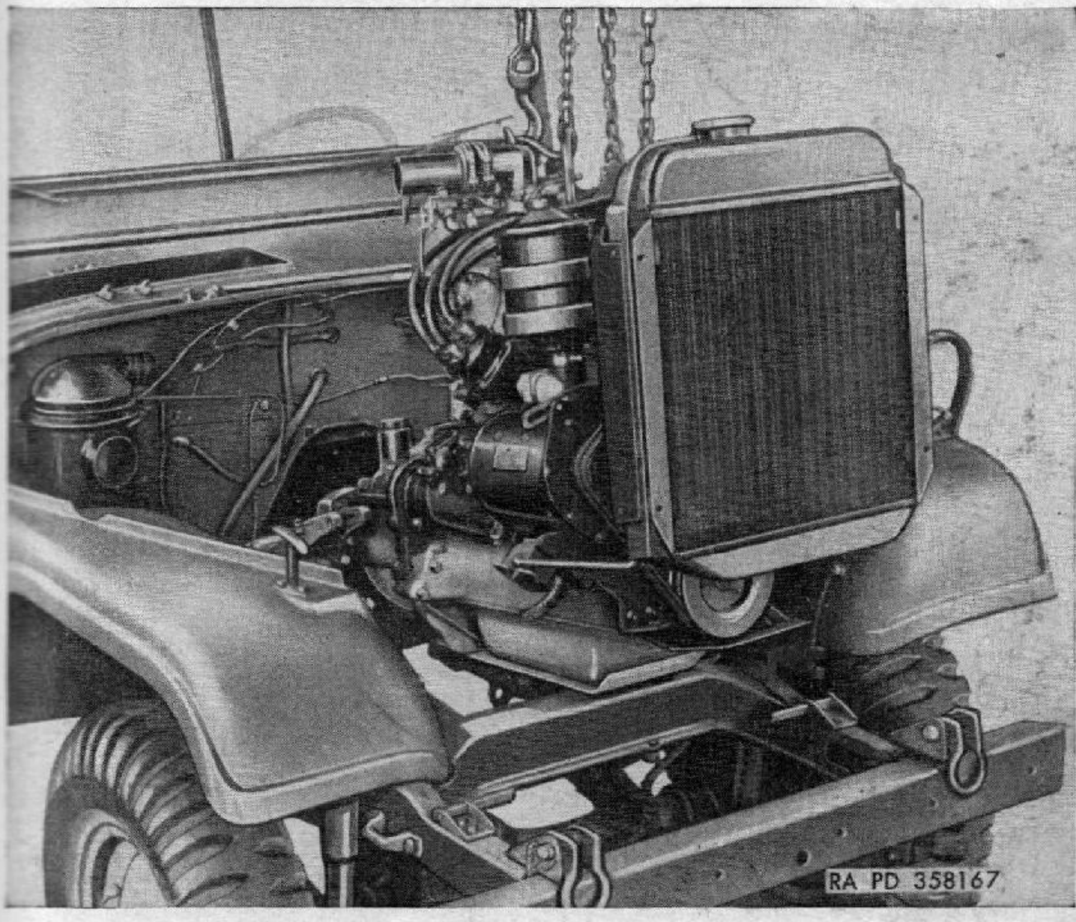


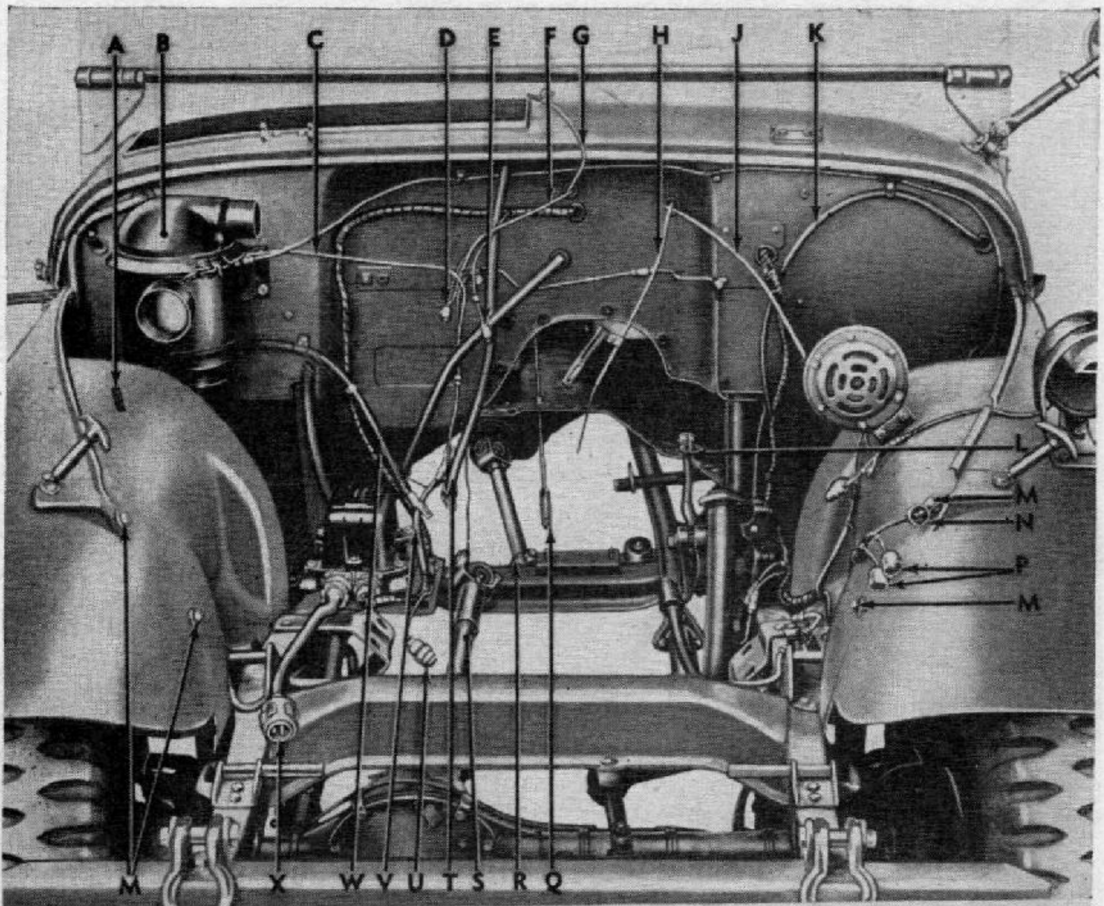
Figure 40. Removing or installing power plant in vehicle.

97. Power Plant Installation

a. Preliminary Instructions. Prior to installation, check to be sure that all lines, cables and parts are installed on power plant that were connected to and removed with it from vehicle. If maintenance work was done on the engine, be sure all adjustments affected are made and corrected. If any components of the power plant were removed and installed, check all connections and related parts to be sure that installations were accomplished correctly.

b. Install Power Plant in Vehicle (fig. 40).

(1) Attach chain hoist to rear portion of engine lifting hook and raise power plant up and roll vehicle under it in position for installation. By a process of gradually lowering the power plant and rolling the vehicle forward install the power plant in the vehicle. While installing the engine, have one helper under the vehicle to insert the rear propeller shaft splines in the sliding yoke (fig. 99). Have another helper, from the passenger compartment, guide the slots in the transmission and transfer support (G, fig. 39) into the bolts in the frame cross member and to install clutch and brake pedal cross shaft into the socket on the transmission.



A—GENERATOR CABLE DISCONNECT DECALCOMANIA
B—CARBURETOR AIR CLEANER
C—TRANSFER VENT LINE
D—ENGINE OIL PRESSURE GAGE SENDING UNIT
E—ENGINE TEMPERATURE GAGE SENDING UNIT
F—VENTILATOR CONTROL CABLE
G—CHOKE CONTROL CABLE
H—THROTTLE CONTROL CABLE
J—VENTILATOR CONTROL CABLE
K—WINDSHIELD WIPER VACUUM HOSE
L—BRAKE PEDAL LEVER
M—GRILLE CAP SCREWS
N—BLACKOUT MARKER LIGHT CABLE CONNECTOR
P—HEAD LIGHT CABLE CONNECTORS
Q—PARKING BRAKE CONTROL ROD
R—REAR PROPELLER SHAFT
S—FRONT PROPELLER SHAFT
T—BATTERY CABLE
U—IGNITION SWITCH CABLE
V—GENERATOR CABLE
W—AUXILIARY POWER CABLE
X—GENERATOR CABLE CONNECTOR

RA PD 358168

Figure 41. Engine compartment with power plant removed.

(2) Before removing chain hoist from engine lifting hook make sure power plant is resting secure.

c. Operations Under Vehicle (fig. 39).

(1) Install two nuts and lock washers securing transmission and transfer support (G) to frame cross members.

(2) Install mounting bolt, flat washer, and mounting nut (B, fig. 38) securing transfer to frame cross member and tighten securely.

(3) Connect speedometer cable (E, fig. 39) by inserting speedometer cable into speedometer driven gear. Secure by tightening knurled coupling to transfer rear bearing cap.

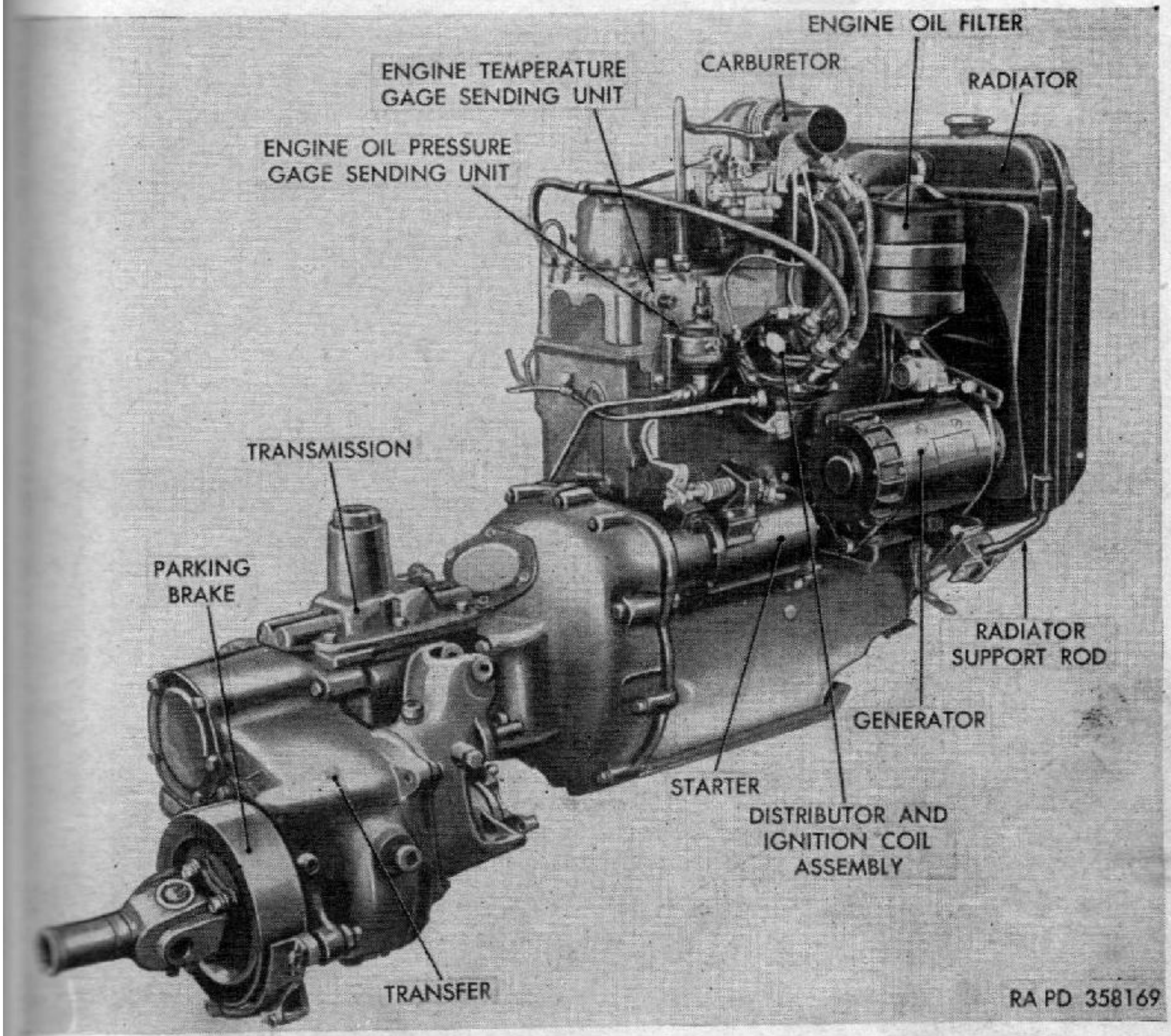


Figure 42. Right rear view of power plant removed.

(4) Connect rear universal joint of front propeller shaft (par. 168). Secure rear propeller shaft to sliding yoke by tightening dust cap onto sliding yoke (fig. 99).

(5) Install parking brake lever (C, fig. 39) in yoke on parking brake control rod (B), install clevis pin and secure with cotter pin.

(6) Insert engine stay cable in stay cable bracket (H) on frame cross member and tighten engine stay cable adjusting nut and secure with lock nut.

d. Operations Inside Passenger Compartment (fig. 37).

(1) Hook brake return spring (E, fig. 38) to brake lever. Install clutch control cable yoke (D) to clutch and brake pedal cross shaft; install clevis pin through yoke and secure with cotter pin.

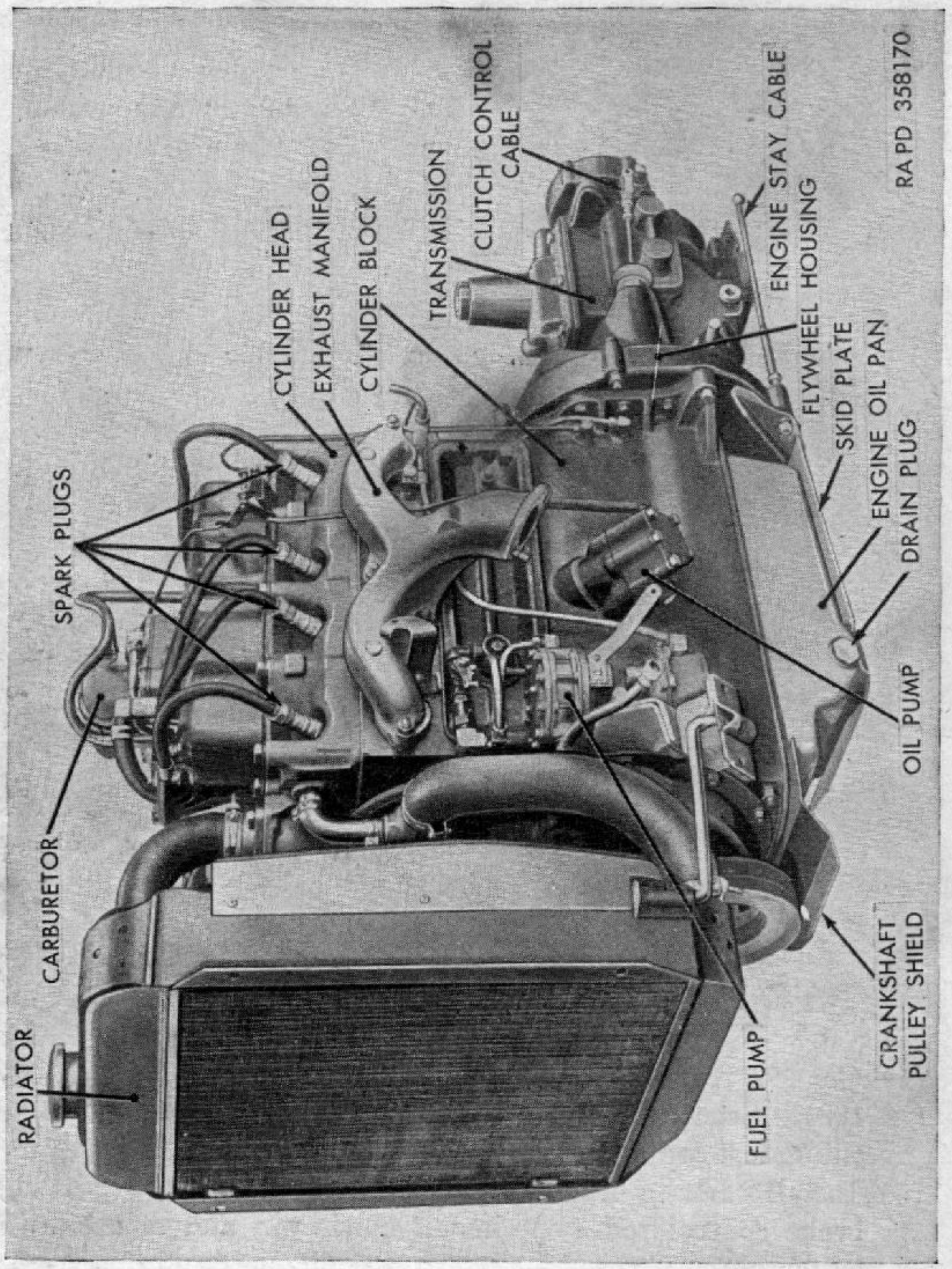


Figure 43. Left front view of power plant removed.

(2) Position the transmission cover plate (H, fig. 37) in vehicle, and install and tighten cap screws.

Note.—Install only 11 cap screws, making certain not to install any screws where other cover plates or toe board extension fit.

(3) Position toe board cover plate (E) and floor board extension (C) in vehicle and secure with cap screws.

Note.—Install only 10 cap screws in toe board and 3 in toe board extension, making certain not to install any screws where other cover plates or toe board extension fit.

Position brake master cylinder inspection cover (K) on transmission cover plate and secure with four cap screws. Position retainer ring (B) and grommet around steering column and secure with four cap screws.

(4) Install transfer shift levers (J) through opening in transmission cover plate (H) and fit transfer shift levers in slots in shifter rails in transfer front bearing cap. Line up transfer shift levers with hole in transfer front bearing cap and install transfer shift lever pivot pin through transfer access plate (G) opening to secure transfer shift levers to transfer front bearing cap. Tighten pivot pin securely. Install lubrication fitting in end of transfer shift levers pivot pin. Install shift lever springs on left side of each transfer shift lever and hook ends around each transfer shift lever. Swing transfer access plate (G) over opening and secure with a cap screw. Install shift lever grommet retaining ring over transfer shift levers until it is flush with transmission cover plate. Secure shift lever grommet retaining ring (F) with four cap screws. Install transfer shift lever knobs.

(5) Push accelerator pedal linkage back through hole in toe board and insert throttle block in upper hole of bellcrank below exhaust manifold and secure with washer and cotter pin.

(6) Remove rag in gearshift lever housing opening. Install transmission gearshift lever (A) in gearshift lever housing and engage transmission gearshift lever with the shifting rail. Screw down gearshift lever housing cap. Position gearshift lever boot around gearshift lever housing; install lower boot clamp (D) and tighten securely.

e. Operations at Left Side of Vehicle (fig. 36).

(1) Install two cap screws (G) and lock washers securing front engine support to frame. From the passenger compartment install brake pedal through opening in toe board and insert shank of brake pedal into the brake pedal lever. Install

cap screw securing brake pedal to brake pedal lever and tighten securely.

(2) Install windshield wiper vacuum hose to the windshield wiper vacuum tee (C).

(3) Place a new exhaust manifold gasket between the exhaust manifold (D) and exhaust pipe (E), connect exhaust pipe to exhaust manifold and secure with safety nut and cap screw.

(4) Connect flexible fuel line (F) to fuel line and turn on fuel shutoff valve.

(5) Install ventilator control cable (B) to lower crankcase ventilator control valve and control cable bracket; tighten set screw on pivot and tighten screw and nut on control cable bracket.

f. Operations at Right Side of Vehicle (fig. 35).

(1) Install ground strap (J) at rear of front engine support and secure ground strap and front engine support with two cap screws (H), nuts, and external tooth lock washers.

Note.—Place an external-tooth lock washer between the nut and the frame, the ground strap and the frame, and the cap screw and the ground strap.

(2) Install air intake hose (A) on carburetor air cleaner and air intake pipe and tighten hose clamps.

(3) Attach the throttle control cable (A, fig. 36), ventilator control cable (D, fig. 35), and control cable to the throttle control lever and secure with set screws. Connect control cable to the control cable brackets and secure with screws and nuts.

(4) Connect cable to engine temperature gage sending unit (B). Connect ignition switch cable (K) to distributor. Connect generator cable to generator connector (F) on generator and tighten connector with spanner wrench 41–W–3249–900 (fig. 70). Connect battery cable (M), generator cable (N), and auxiliary power cable to starter switch terminal (L), and secure with flat washer and nut.

g. Operations at Front of Vehicle. Install grille, alining flat section of hinge pin with slot in hinge and swing grille up until slots in grille enter the cap screws on both front fenders. Make sure flat washer is between cap screw and flange on grille. Install four radiator to grille screws (G, fig. 35) (two on each side) securing radiator to grille and tighten screws. Tighten six (three on each side) cap screws securing fenders to grille. Connect headlight and blackout marker light cable connectors (fig. 34). Connect battery ground cable (fig. 78) and install the hood (par. 216).

h. Final Check and Inspection.

(1) Visibly check engine, transmission, and transfer to be sure that all connections have been made. Check fuel, oil, and water supply.

(2) Start the engine and check the installation. Check instrument panel gages and controls to assure proper operation.

i. Record of Replacement. Make a record of the power plant replacement on DA Form 478 (MWO and Major Unit Assembly Replacement Record and Organizational Equipment File).

Section VII. ENGINE REMOVAL AND INSTALLATION

98. Coordination With Ordnance Maintenance Unit

Replacement of the engine with a new or reconditioned engine is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation which are not carried by the using organization may be obtained from the supporting ordnance maintenance unit.

99. Removal

a. General. Removal or replacement of the engine requires complete power plant removal.

b. Remove Power Plant. Refer to paragraph 96.

c. Remove Transfer. Refer to paragraph 164.

d. Remove Transmission. Refer to paragraph 160.

e. Remove Clutch. Refer to paragraph 157.

f. Remove Radiator. Drain radiator by opening radiator drain valve. Loosen hose clamp securing water outlet hose and water inlet hose (fig. 71) and pull hoses from radiator. Lift up on radiator to disconnect radiator from radiator support rods (fig. 42) and remove radiator.

100. Installation

a. General. All cables, connections, parts, and accessories, which were removed from the vehicle with the engine being replaced and which were not furnished with the new or rebuilt engine, must be removed from the engine being replaced and installed on the new or rebuilt engine being used before installation of engine into the vehicle.

b. Install Radiator. Carefully install radiator on radiator support rods (fig. 42). Do not rub fan against the fins of the radiator. Install water inlet hose (fig. 71) and water outlet hose on radiator and tighten hose clamps.

c. Install Clutch. Refer to paragraph 157.

d. Install Transmission. Refer to paragraph 161.

e. Install Transfer. Refer to paragraph 165.

f. Fill Cooling System. Refer to paragraph 121.

g. Install Power Plant. Refer to paragraph 97.

h. Record of Replacement. Make a record of the engine replacement on DA Form 478.

Section VIII. FUEL AND AIR INTAKE SYSTEM

101. Description and Data

a. Description.

(1) *General.* Units which comprise the fuel and air intake system (fig. 44) include carburetor, carburetor controls, carburetor air cleaner, fuel tank, fuel pump, fuel filter, fuel gage, fuel gage sending unit and connecting fuel lines, and electric cables which connect these various components.

(2) *Carburetor.* The carburetor (fig. 46) is a special waterproof, single venturi, downdraft type which is sealed at the control and adjustment connections through the housing. All of the metering jets and passages are located to provide for correct metering of fuel and air at all practical operating ranges. The carburetor is vented through the float chamber to provide for underwater operation. The carburetor is mounted on the cylinder head directly over the center of the sealed-in intake manifold. The carburetor is manually controlled by the driver through the accelerator pedal, choke and throttle controls, with connecting control cables and rods.

(3) *Fuel pump.* The fuel pump (fig. 50) is mounted on the left side of the cylinder block at the front of the engine. This fuel pump is a combination fuel pump and vacuum booster with the vacuum pump providing more constant vacuum for windshield wiper operation. The fuel pump is of the diaphragm type, mechanically operated from an eccentric on the camshaft. The fuel pump is equipped with a hand priming lever (fig. 50) which may be used to manually pump fuel into the carburetor float bowl.

(4) *Carburetor air cleaner.* The carburetor air cleaner (fig. 45) is an oil-bath type specially designed and adapted for underwater operation. The air cleaner is mounted on the right

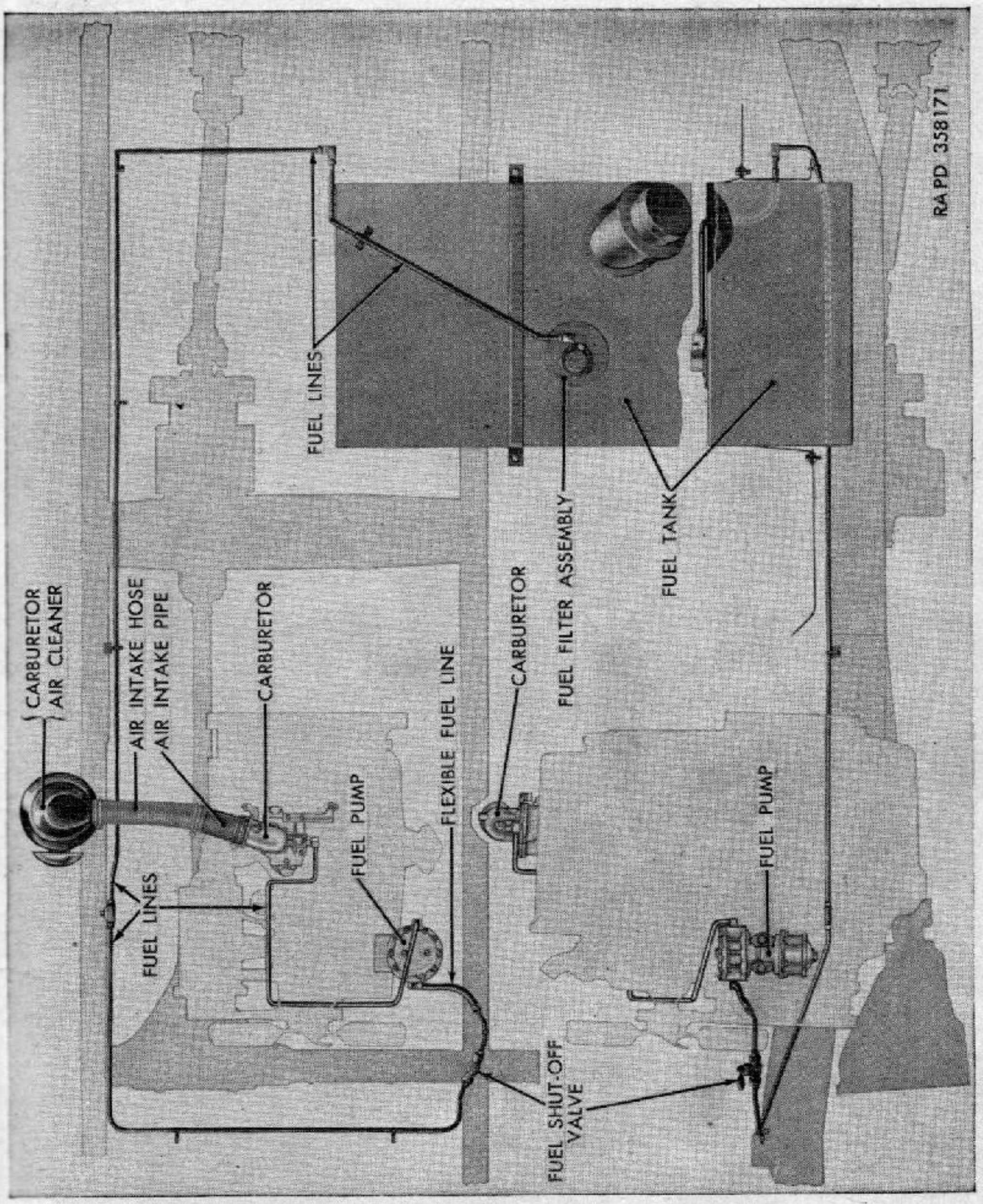


Figure 44. Fuel and air intake system.

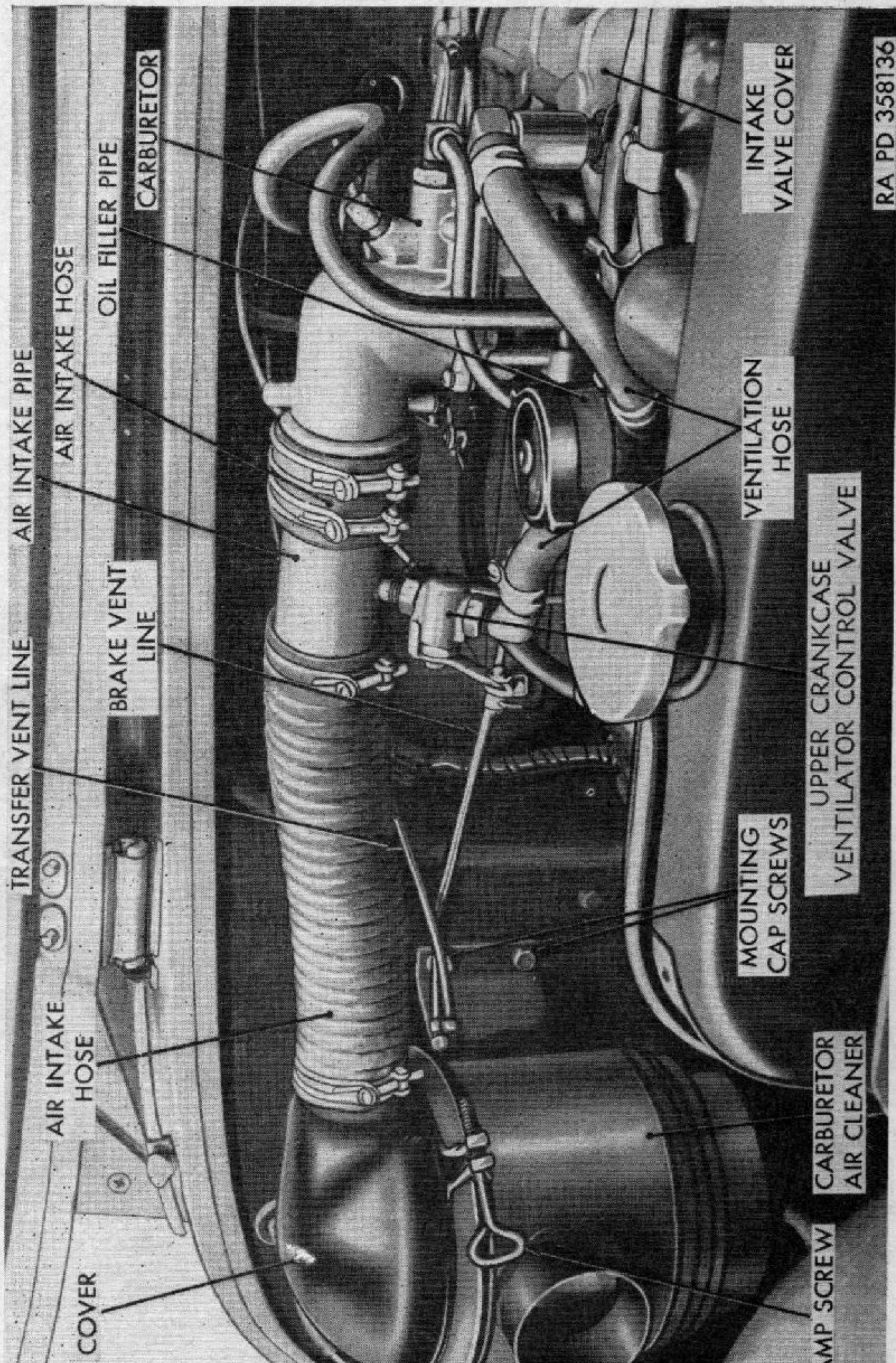


Figure 45. Carburetor and carburetor air cleaner installed.

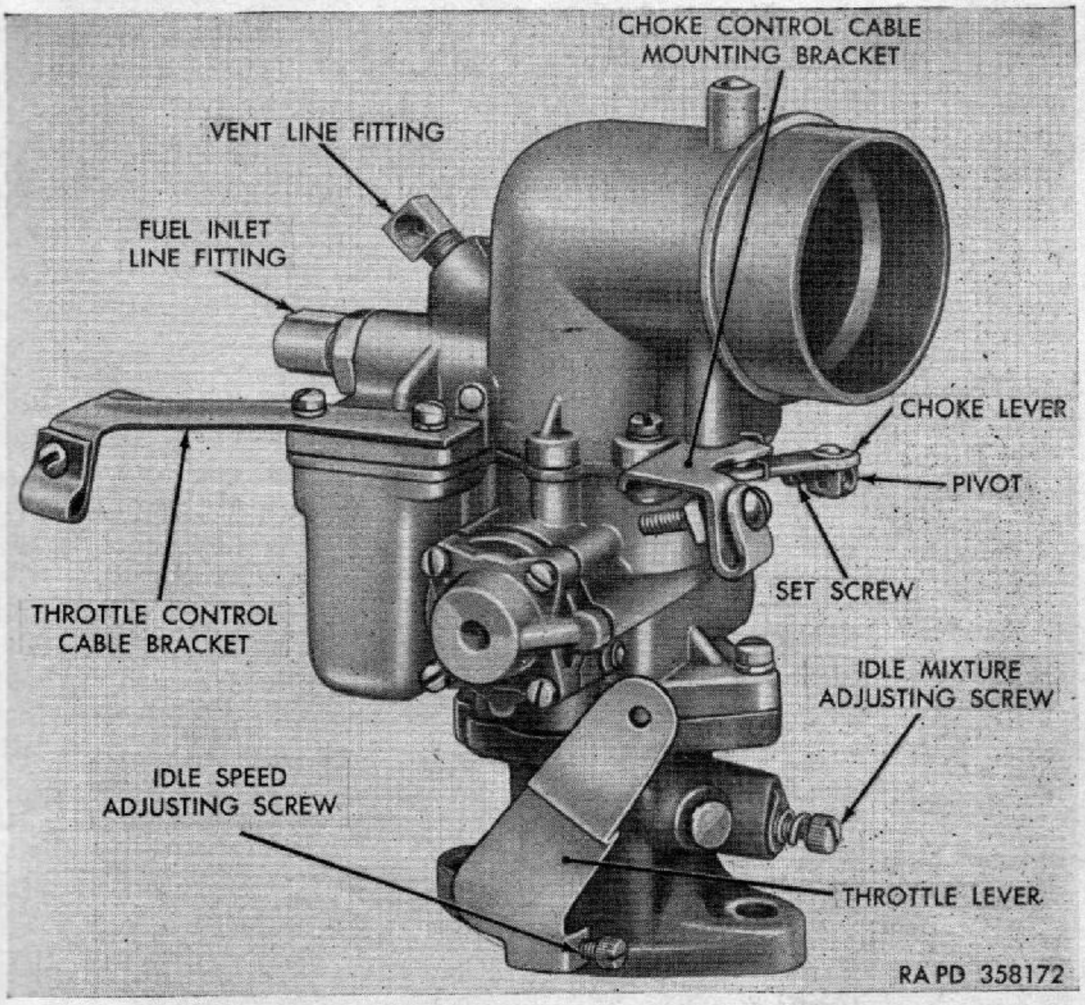


Figure 46. Carburetor.

side of the engine compartment and is connected to the carburetor by flexible air intake hoses and a solid air intake pipe. A fitting at the front provides for clamping on the fording kit air intake pipe extension. Air drawn through the side opening or precleaner (fig. 54) passes into an oil chamber where most of the dust is deposited in the oil saturated wire mesh of the air cleaner element (fig. 54). From the air cleaner element the air passes through connecting hoses and pipes to the carburetor. Vent lines from the fuel tank, carburetor, brake master cylinder, crankcase, distributor, and transfer are connected either directly or indirectly to the carburetor air cleaner.

(5) *Fuel tank and fuel lines* (fig. 53). The pressurized fuel tank is located on the left side of the vehicle under the driver's seat. The fuel filler cap is located in a recess in the left body side panel and is marked with a warning to open

slowly. Installed in the fuel tank are the fuel gage sending unit and the fuel filter. Fuel lines connect the fuel tank to the fuel pump and other components of the fuel system. A fuel shut-off valve (fig. 44) is incorporated in the main fuel line to shut off the supply of fuel from the fuel tank to the fuel pump.

b. Data.

Carburetor:	
Manufacturer	Carter
Model	YS 950S
Type	downdraft
Fuel pump:	
Manufacturer	AC Spark Plug Div
Pressure	4½ to 5 psi at 1,800 rpm
Type	diaphragm-camshaft drive
Vacuum	10 in. at 200 rpm, 12 in. at 1,500 rpm
Carburetor air cleaner:	
Capacity	1½ pt
Manufacturer	United Specialties
Type	oil-bath
Fuel tank:	
Capacity	17½ gal

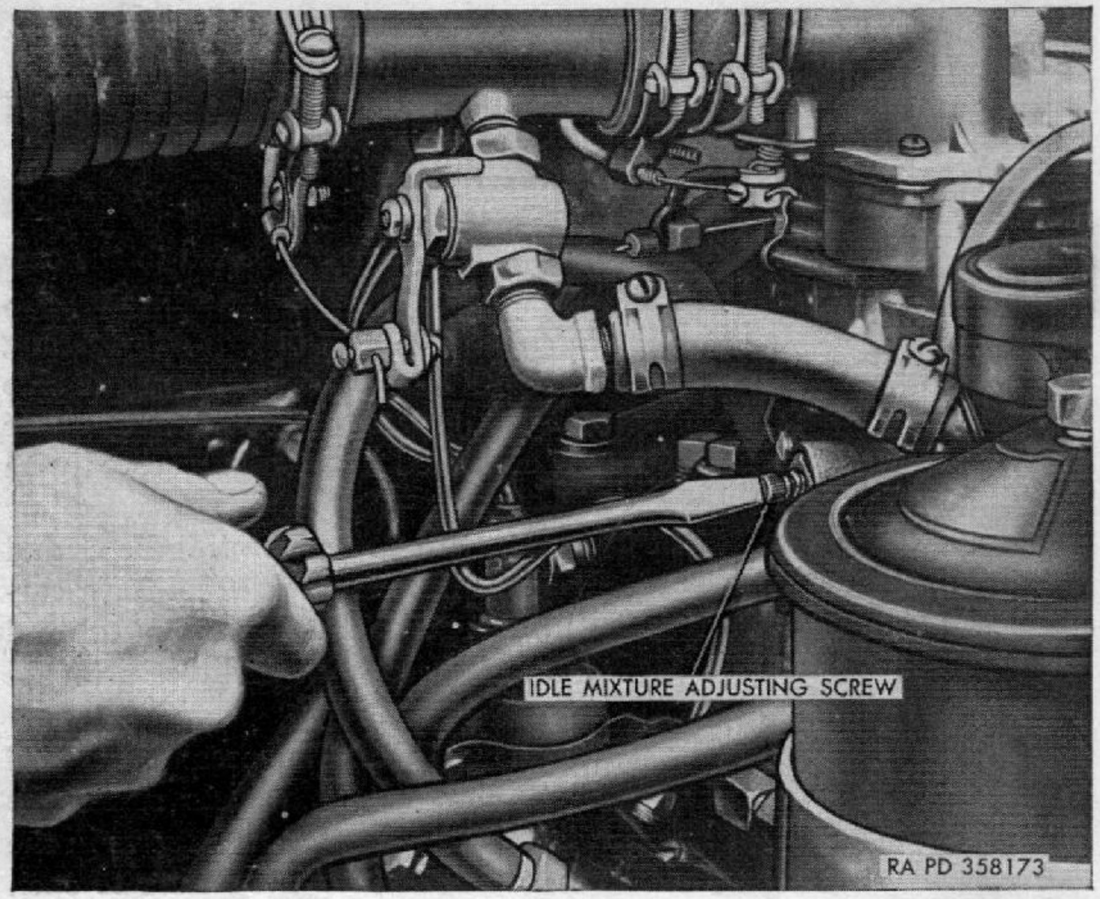


Figure 47. Adjusting carburetor idle mixture.

102. Carburetor

a. Adjustments. Adjustment of the carburetor is accomplished by means of the idle mixture adjusting screw (fig. 46) and the idle speed adjusting screw. Make all carburetor adjustments with the engine running at normal operating temperatures (160° to 180° F.). Turning the idle mixture adjusting screw to the right, or in, makes the fuel mixture leaner; turning it to the left, or out, increases the mixture or makes it richer. To adjust the idle mixture, turn the idle mixture adjusting screw (fig. 47) in until it just touches the needle seat or the engine begins to lag; then turn out one half to one full turn. Care should be exercised not to jam the idle mixture adjusting needle against the seat tight enough to damage the threads or groove the point. If this occurs, the idle mixture adjusting screw will have to be replaced before satisfactory adjustment can be made. The idle speed adjusting screw on the throttle lever (fig. 46) should be set to idle the engine at approximately 600 rpm.

b. Removal.

(1) Disconnect the choke control cable, throttle control cable, and ventilator control cable and remove intake valve cover (par. 91*a*(2), (3), and (5)).

(2) Disconnect vent line from vent line fitting (fig. 46) on top of carburetor. Disconnect fuel inlet line (fig. 48) from fitting on carburetor. Remove cotter pin and unlock throttle control rod (fig. 25) from throttle lever.

(3) Loosen hose clamp at carburetor and remove air intake hose (fig. 45) from carburetor.

(4) Remove the two flange nuts (fig. 48) securing carburetor to carburetor mounting studs on cylinder head and lift off the carburetor. Remove the carburetor gasket and discard.

Note.—Measure thickness of carburetor gasket so that same thickness of gasket may be installed.

c. Installation.

(1) Place a new carburetor gasket on carburetor mounting studs. Place carburetor over carburetor mounting studs and install and tighten the two flange nuts (fig. 48) securely.

(2) Connect fuel inlet line (fig. 48) and vent line to fittings on carburetor. Tighten connections securely. Place throttle control rod (fig. 25) in hole in throttle lever and install cotter pin.

(3) Place air intake hose (fig. 45) on carburetor and tighten hose clamp securely.

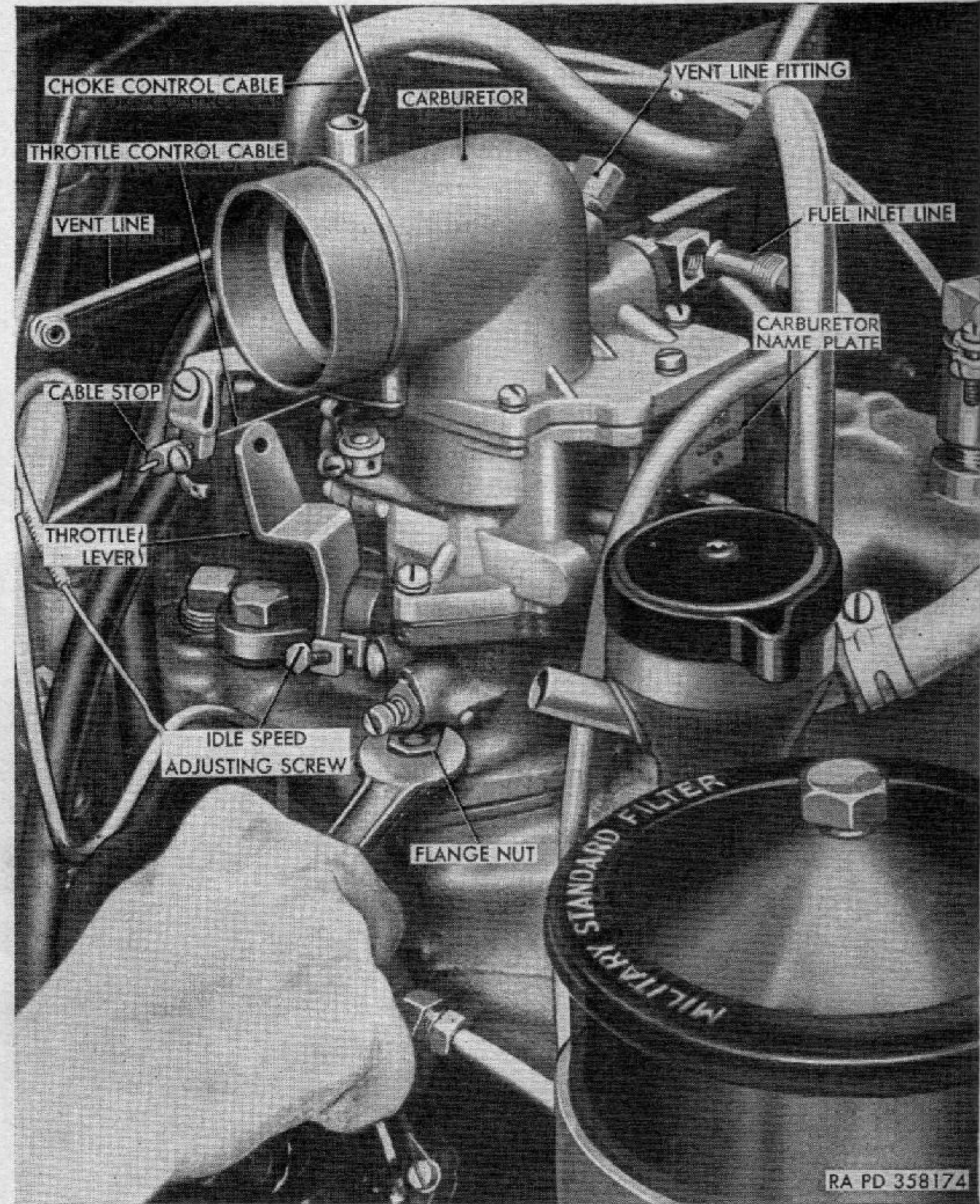


Figure 48. Removing carburetor.

(4) Install the intake valve cover and connect the choke control cable, throttle control cable, and ventilator control cable (par. 91*b*(7), (9), and (10)).

103. Carburetor Controls

a. Accelerator Pedal Adjustment (fig. 49). The throttle control rod and accelerator pedal are adjusted by means of the adjusting nuts and adjusting block. The accelerator pedal should be set to just strike the floor board with the throttle wide open. Loosen the lock

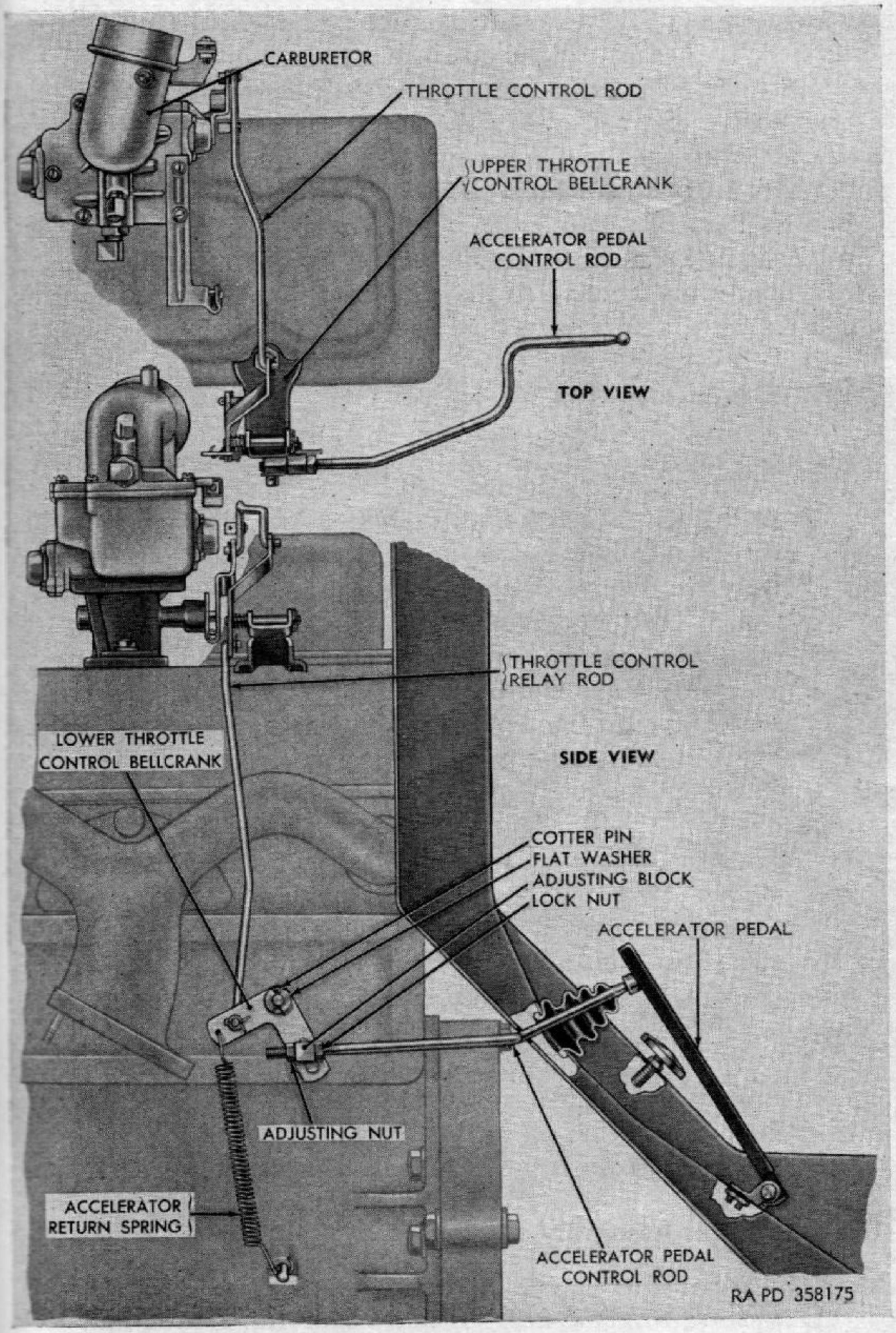


Figure 49. Carburetor controls.

nuts and turn the adjusting nut in or out against the adjusting block until the desired adjustment is obtained.

b. Control Cable Adjustment. Both choke control cable and throttle control cable (fig. 48) are adjusted in relatively the same manner. To adjust the choke control cable, loosen the set screw in pivot on choke lever. Push the choke forward (open) as far as it will go and tighten the set screw. To adjust the throttle control lever, push the throttle control (fig. 6) all the way in against the instrument panel. Loosen the set screw in the cable stop (fig. 48) and slide cable stop up tight against swivel on throttle lever.

104. Fuel Pump

(fig. 50)

a. Removal.

(1) Turn off fuel shut-off valve (fig. 44). Disconnect flexible fuel line, fuel outlet line, and fuel pump vacuum booster line from fuel pump. Disconnect windshield wiper vacuum line from the bottom part of fuel pump.

(2) Remove mounting cap screws, fuel pump, and fuel pump gasket from cylinder block. In some cases, a spacer will be found between the fuel pump and cylinder block to regulate spacing of fuel pump operating lever and camshaft. Remove spacer and gasket.

b. Installation.

(1) Insert mounting cap screws (fig. 50) through holes in flange of fuel pump, placing the longer of the two in the forward flange hole. Install fuel pump gasket over mounting screws and, if used, install spacer and gasket over mounting screws. Place fuel pump against cylinder block and secure with mounting screws.

(2) Connect flexible fuel line, fuel pump vacuum booster line, and windshield wiper vacuum line on fittings on fuel pump. Turn on fuel shut-off valve (fig. 44).

(3) Start engine and inspect fuel pump and connections for leaks.

105. Fuel Filter Assembly

a. Removal.

(1) *Remove driver's seat.* Remove four cap screws and lock washers securing driver's seat to body side panel, floor pan, and wheel housing and remove driver's seat.

(2) *Remove fuel filter assembly* (figs. 51 and 53). Disconnect fuel line and vent line (fig. 51) from connections on fuel filter assembly. Remove 12 screws and lock washers securing fuel

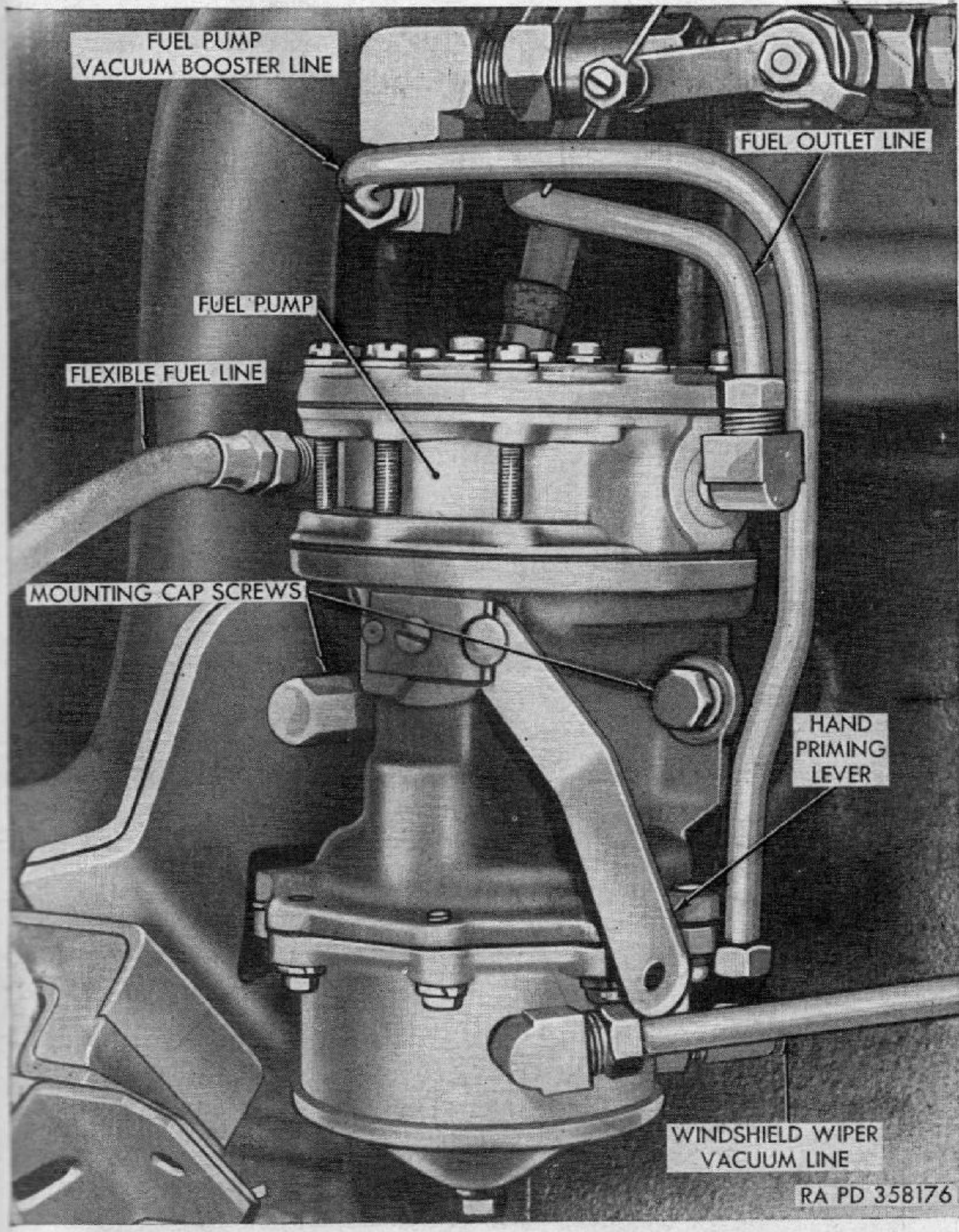


Figure 50. Fuel pump installed.

filter assembly to fuel tank and carefully lift fuel filter and rubber gasket assembly from fuel tank.

Warning.—While removing fuel filter assembly, do not allow sparks or open flame to come near fuel tank as fuel may explode since fuel does not have to be drained to remove fuel filter assembly.

(3) *Remove fuel filter element* (fig. 52). Unscrew connector attaching vent line to cover plate of fuel filter assembly. Loosen screw and nut securing fuel filter element to filter

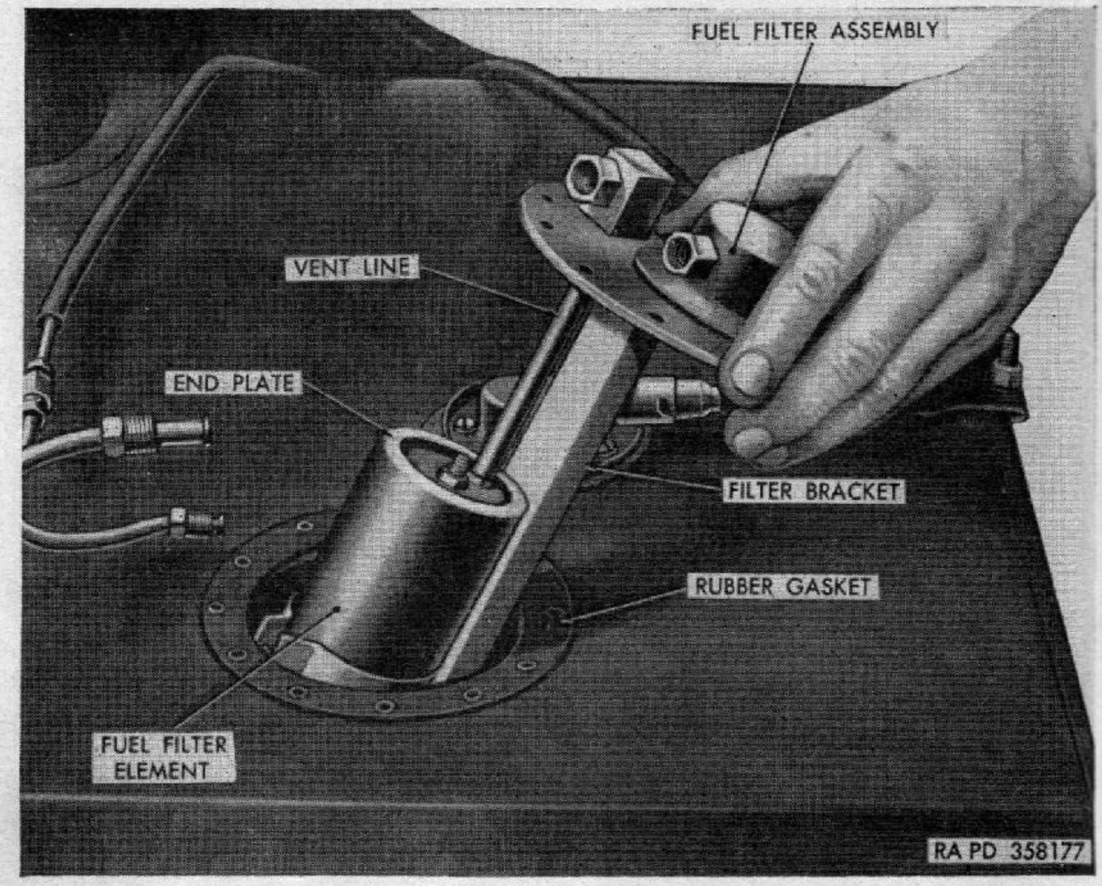


Figure 51. Removing fuel filter assembly.

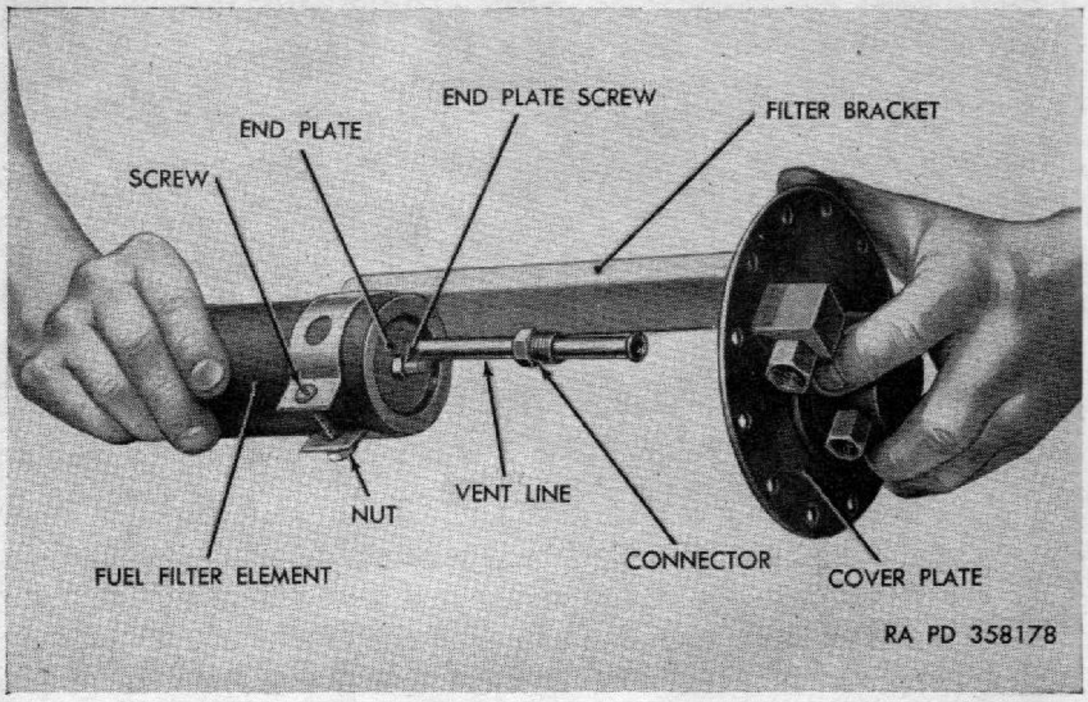


Figure 52. Removing fuel filter element.

bracket and remove fuel filter element. Remove nut from end plate screw and remove end plate screw. Remove upper end plate with vent line attached; then remove lower end plate.

b. Installation.

(1) *Install fuel filter element* (fig. 52). Place lower end plate and upper end plate, with vent line attached, on fuel filter element and secure with end plate screw and nut. Place fuel filter element through clamps on filter bracket and connect vent line to cover plate of fuel filter assembly with the connector. Tighten screw and nut securing fuel filter element to filter bracket.

(2) *Install fuel filter assembly* (figs. 51 and 53). Place rubber gasket on fuel tank and line up holes; install fuel filter assembly in full tank. Secure fuel filter assembly to full tank with 12 screws and lock washers. Connect fuel line and vent line to fittings on fuel filted assembly and tighten connections securely.

(3) *Install driver's seat.* Position driver's seat over fuel tank, secure left side to side panel and wheel housing with cap screws and lock washers, and right side to floor pan with cap screws and lock washer.

106. Fuel Tank

a. Removal.

(1) Remove drain plug in bottom of fuel tank and drain fuel from fuel tank. Remove driver's seat (par. 214).

(2) Disconnect fuel line and vent line (fig. 53) from fuel filter assembly. Disconnect cable, at connector, from fuel gage sending unit. Remove fuel filter cap.

(3) Remove cap screws securing mounting clamp at front and rear of fuel tank, and remove fuel tank easing fuel filter neck out of rubber grommet (fig. 53).

b. Installation.

(1) Position fuel tank (fig. 53) in vehicle, inserting the fuel filter neck through the rubber grommet. Position mounting clamp across fuel tank; secure to floor pan at front and rear of fuel tank with cap screws and lock washers.

(2) Install fuel filter cap and connect cable to fuel gage sending unit (fig. 53). Connect fuel line and vent line to fuel filter assembly (fig. 53) and tighten connections.

(3) Install driver's seat (par. 214) and fill fuel tank with fuel.

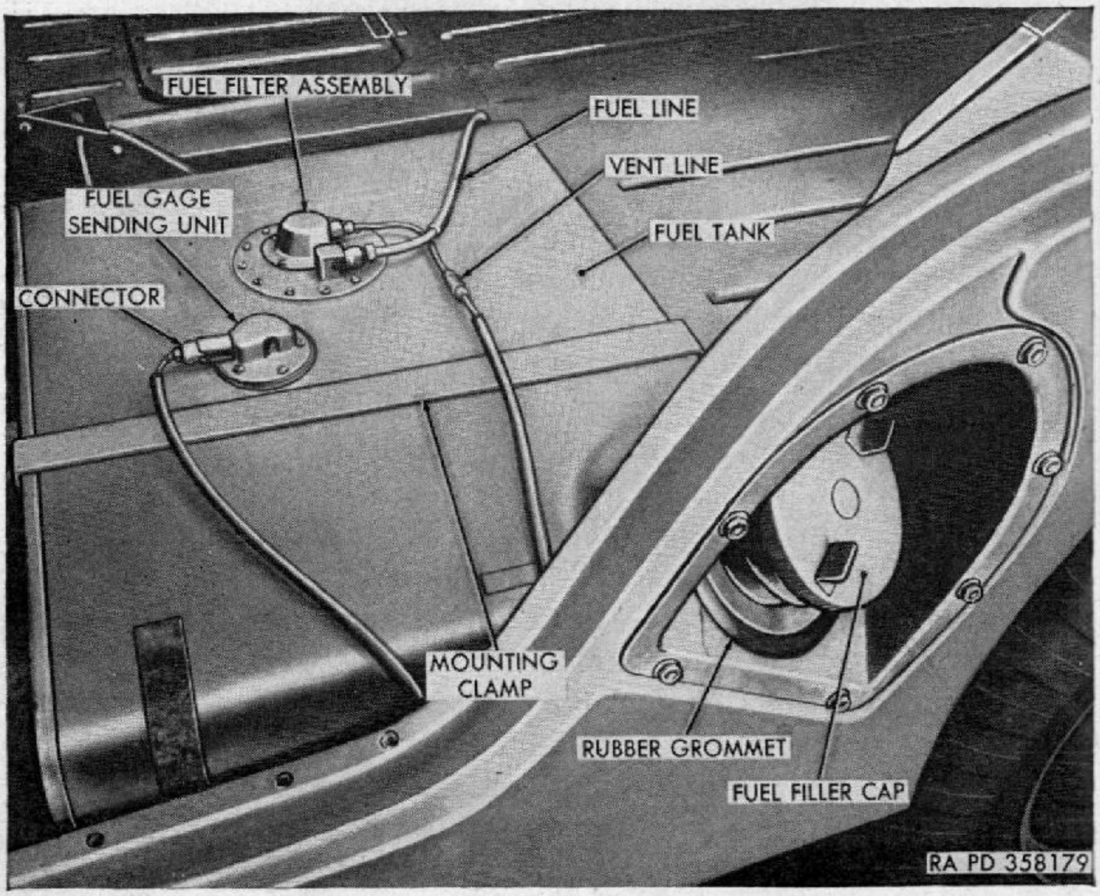


Figure 53. Fuel tank installed.

107. Carburetor Air Cleaner

a. Servicing. Loosen hose clamps securing air intake hose (fig. 45) to cover and pull off air intake hose. Loosen clamp screw and lift off cover. Lift out air cleaner element (fig. 54) with baffle attached. Reach down in air cleaner body and lift out oil cup. Pour old oil out and clean oil cup in dry-cleaning solvent or volatile mineral spirits. Place fresh engine oil in oil cup to level indicated on side of oil cup. Place oil cup in air cleaner body making certain it seats correctly. Place air cleaner element with baffle attached in air cleaner body making sure it seats correctly. Position cover on air cleaner securing with clamp ring (fig. 54) and tighten clamp screw (fig. 45). Connect air intake hose to air cleaner and tighten hose clamps.

b. Removal. Loosen hose clamps and remove air intake hose (fig. 45) from cover. Disconnect brake vent line and transfer vent line from air cleaner body. Remove four mounting cap screws securing carburetor air cleaner to vehicle and remove carburetor air cleaner.

c. Installation. Position carburetor air cleaner on vehicle and secure with four mounting cap screws (fig. 45). Connect transfer vent line and brake vent line to side of air cleaner body and tighten securely. Install air intake hose on cover and tighten hose clamps.

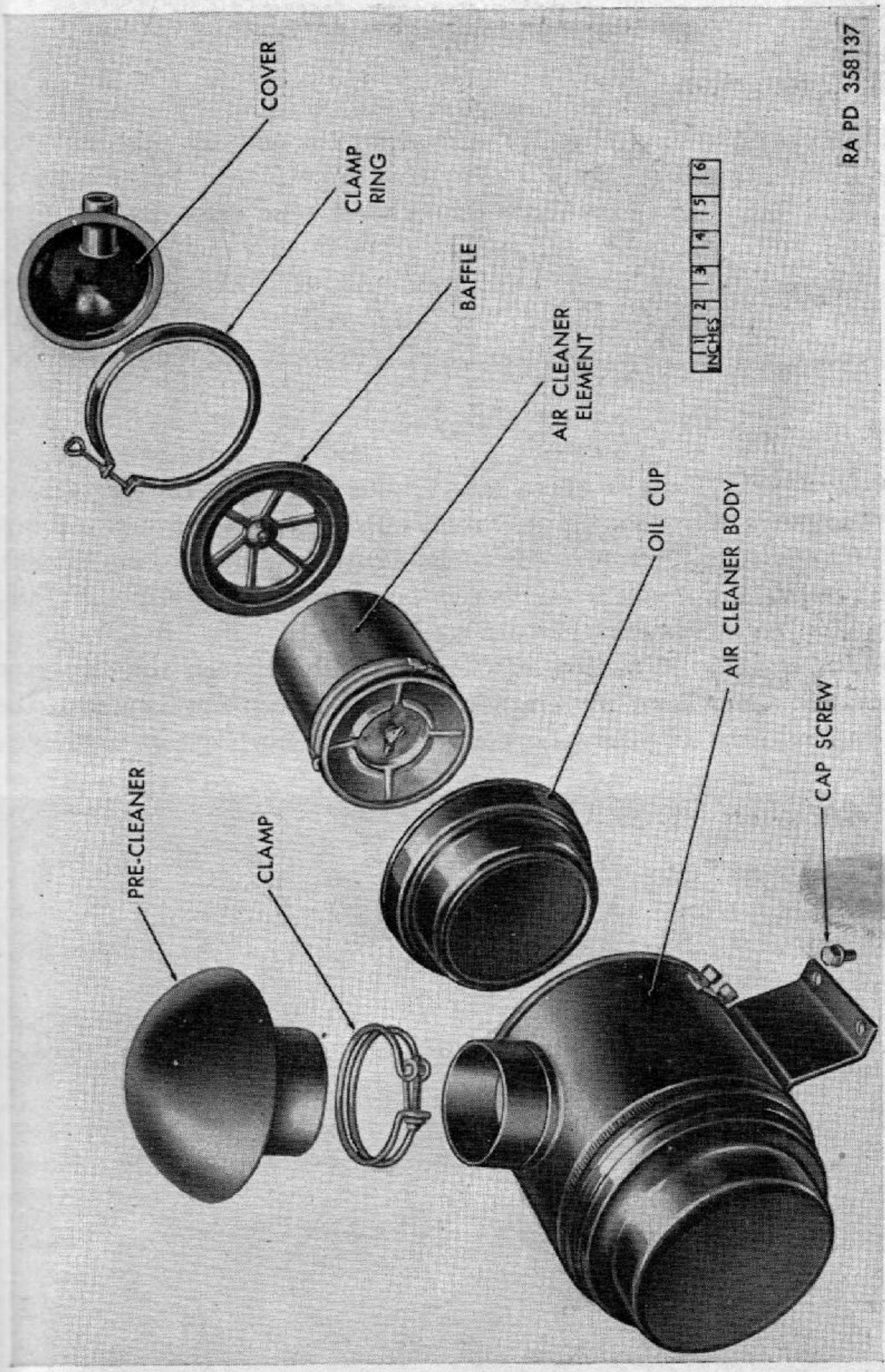


Figure 54. Carburetor air cleaner—exploded view.

Section IX. EXHAUST SYSTEM

108. Description

The exhaust system (fig. 55) consists of the exhaust pipe, exhaust pipe extension and muffler. The exhaust pipe fastens to the exhaust manifold flange and extends to the exhaust pipe extension which is fastened to the flange on the muffler. The muffler mounts to the exhaust pipe extension flange and is mounted diagonally between the last two frame cross members. The tail pipe is part of the muffler and is supplied with a flange for attaching the extension of the fording kit.

109. Muffler

a. Removal. Remove three safety nuts and cap screws attaching muffler flange to exhaust pipe extension flange. Remove cap screw mounting muffler support bracket (fig. 55) to rear frame cross member and remove the muffler and gasket between flanges of muffler and exhaust pipe extension. Discard gasket.

b. Installation. Position muffler (fig. 55) between the two rear frame cross members; place a new gasket between the flanges of the muffler and exhaust pipe extension, install three cap screws in flanges,

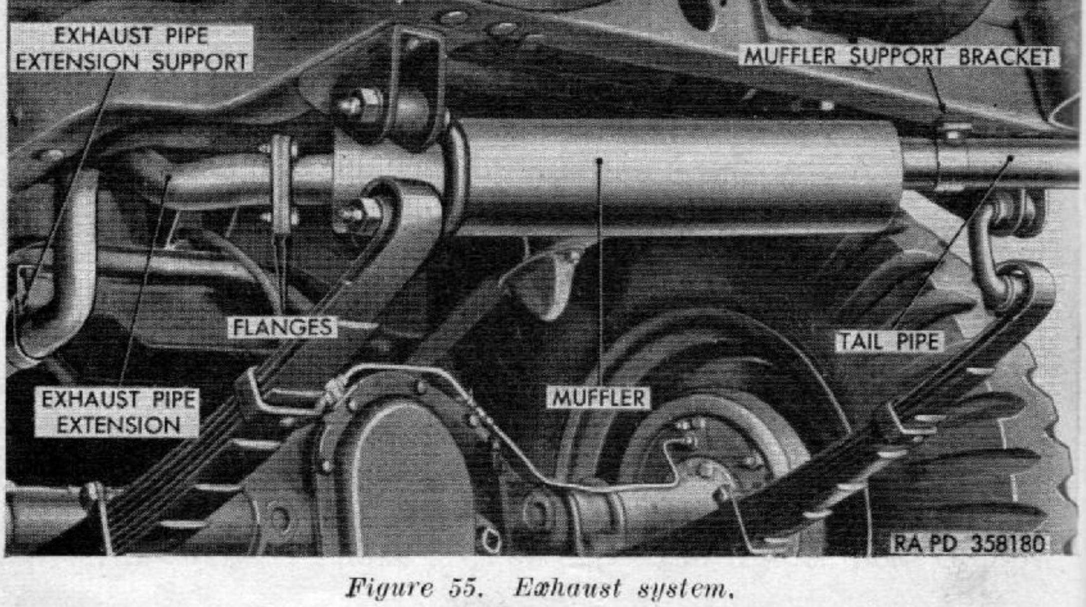


Figure 55. Exhaust system.

and secure with three safety nuts. Secure muffler support bracket to rear frame cross member with cap screw and lock washer.

110. Exhaust Pipe and Exhaust Pipe Extension

a. Removal. Remove safety nut and safety nut and cap screw, connecting exhaust pipe to exhaust manifold. Remove three safety nuts and cap screws attaching muffler flange to exhaust pipe extension flange. Remove cap screw, lock washer, and nut securing exhaust pipe extension support (fig. 55) and remove exhaust pipe and exhaust pipe extension. Remove gaskets from between exhaust pipe and exhaust manifold and exhaust pipe extension and muffler. Remove three safety nuts and cap screws connecting exhaust pipe to exhaust pipe extension and remove gasket.

b. Installation. Connect exhaust pipe to exhaust pipe extension (fig. 55) using new gasket and secure with three cap screws and safety nuts. Lift exhaust pipe and extension into position and secure exhaust pipe extension support with cap screw, lock washers, and nut. Connect exhaust pipe extension to muffler using a new gasket and secure with three cap screws and safety nuts. Connect exhaust pipe to exhaust manifold using a new gasket; secure safety nut, cap screw, and safety nut. Make sure all connections are tightened securely to prevent leakage.

Section X. IGNITION SYSTEM

111. Description and Data

a. Description.

(1) *General.* The ignition system circuit (fig. 56) consists of the source of power (battery or generator), ignition switch, ignition coil, distributor, spark plugs, and primary and secondary circuit wiring connecting the various units. The ignition system produces and delivers high voltage current to the spark plugs at timed intervals. Each high voltage surge produces a spark at the spark plug electrode to which it is delivered, igniting the air and fuel mixture in the combustion chamber. The entire ignition system is completely shielded for radio interference suppression and sealed for submerged operation.

(2) *Distributor and ignition coil assembly* (fig. 57). The distributor and ignition coil assembly is a unit designed to convert the low voltage (primary circuit) into high voltage (secondary circuit); to distribute the high voltage to the

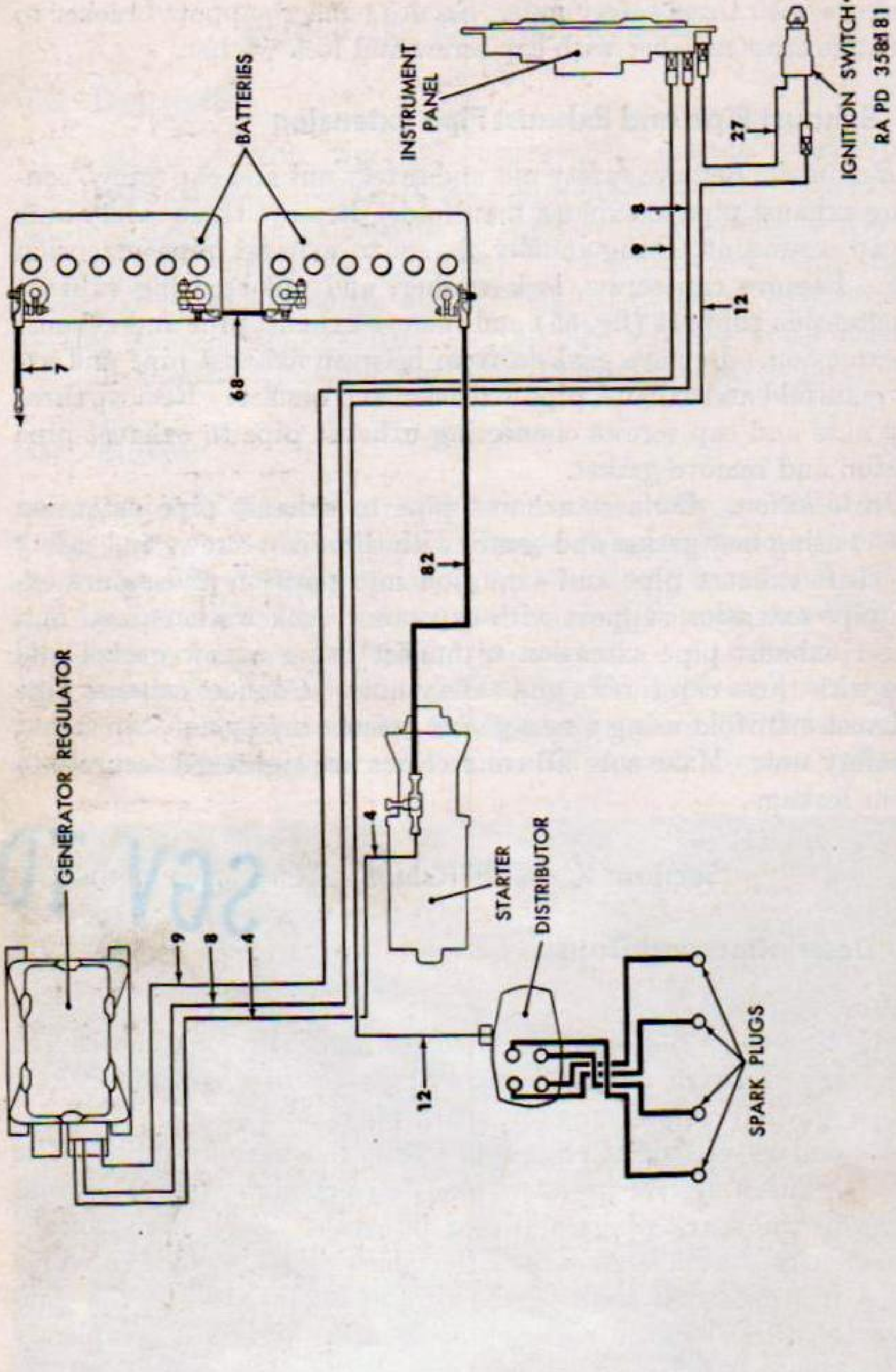


Figure 56. Ignition system circuit.

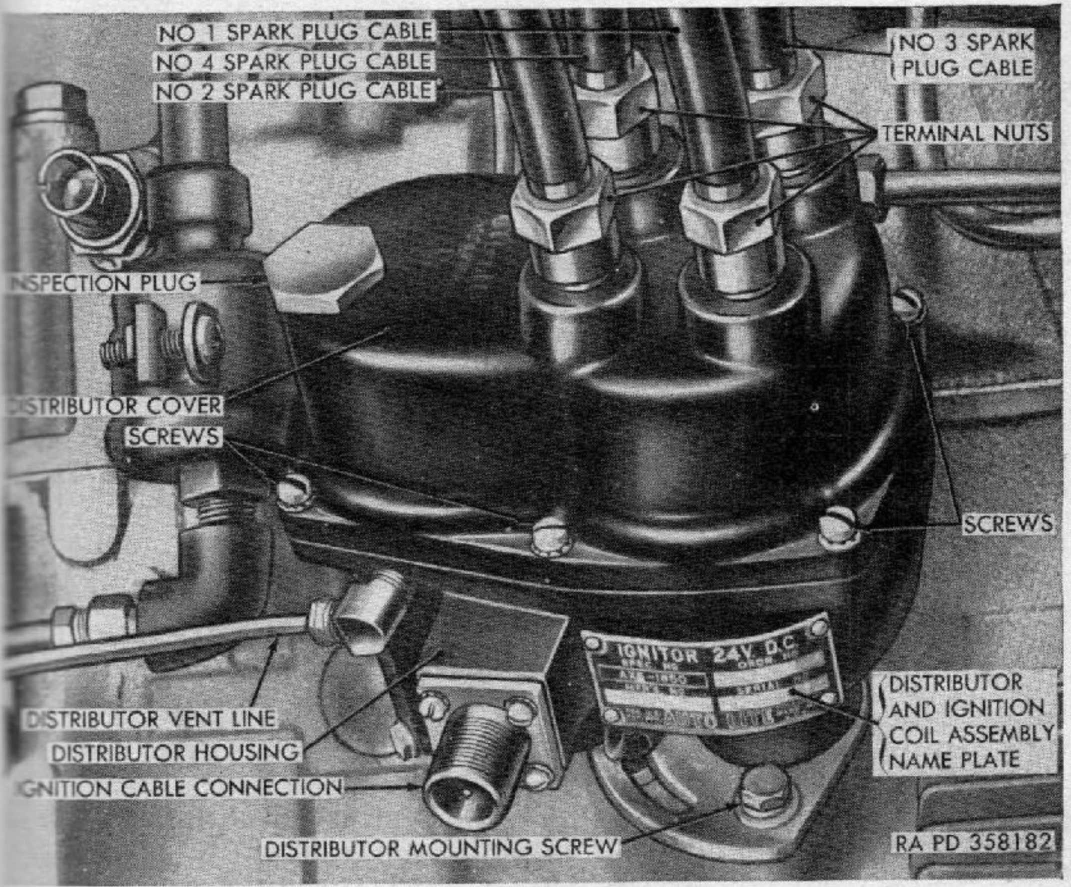


Figure 57. Distributor and ignition coil assembly mounted on engine.

spark plugs; and to vary the timing of the spark automatically to provide for efficient operation of the engine. The distributor mechanism, ignition coil, and capacitor are assembled in the distributor housing which is mounted on the right side of the engine. The distributor shaft is driven by the camshaft.

(3) *Spark plugs* (fig. 25). Each spark plug consists of a shell, insulator, and center electrode. The center electrode is completely insulated from the shell by the insulator. A grounded electrode is integral with the shell. When high voltage surge is delivered to the spark plug center electrode, it jumps the gap to the grounded electrode, producing a spark which ignites the air-fuel mixture in the combustion chamber.

(4) *Circuits* (fig. 56). There are two distinct circuits in the ignition system, the primary and the secondary. The primary, or low voltage circuit, includes the source of electrical energy (battery or generator), ignition switch, distributor breaker points, primary winding of the ignition coil, and capacitor. The secondary, or high voltage circuit, includes

the secondary winding of the ignition coil, distributor rotor and cap, spark plug cables, and spark plugs.

b. Data.

Distributor and ignition coil assembly:	
Manufacturer	Auto-Lite
Rotation	counterclockwise
Type of advance	centrifugal
Breaker point opening	0.020 in
Breaker arm spring tension	17 to 20 oz
Firing order	1-3-4-2
Capacitor capacity	0.25 to 0.26 mfd
Voltage	24
Ignition coil:	
Manufacturer	Auto-Lite
Voltage	24
Spark plugs:	
Ordnance number	7524258
Thread size	14 mm
Gap	0.030 in

112. Ignition Timing

a. General. The timing of the ignition consists of the setting of the distributor mechanism to cause opening of distributor breaker points at correct firing intervals. Due to the sealed design of the ignition system, an adapter (fig. 59) is required for connecting the timing light.

b. Ignition Timing.

(1) Note location of number one spark plug cable (fig. 57) and scribe a mark with chalk on the distributor housing at this point.

(2) Remove six screws with internal tooth lock washers securing distributor cover (fig. 57) to distributor housing and remove distributor cover. Clean and adjust or replace distributor breaker points (par. 113*a*) if necessary.

(3) Do not turn ignition switch on. Slowly turn engine by cranking intermittently with starter until timing mark (fig. 58) (notch on crankshaft pulley) is alined with 5-degree marks on timing gear cover (fig. 58). If rotor segment points toward mark indicating No. 1 spark plug cable location, proceed with (4) below. If rotor segment points toward No. 3 spark plug location, turn engine over one complete revolution until rotor segment points to No. 1 position with timing marks alined.

(4) Install distributor cover, making certain that gasket (fig. 60) is in good condition and in place. Install and tighten six screws with internal-tooth lock washers.

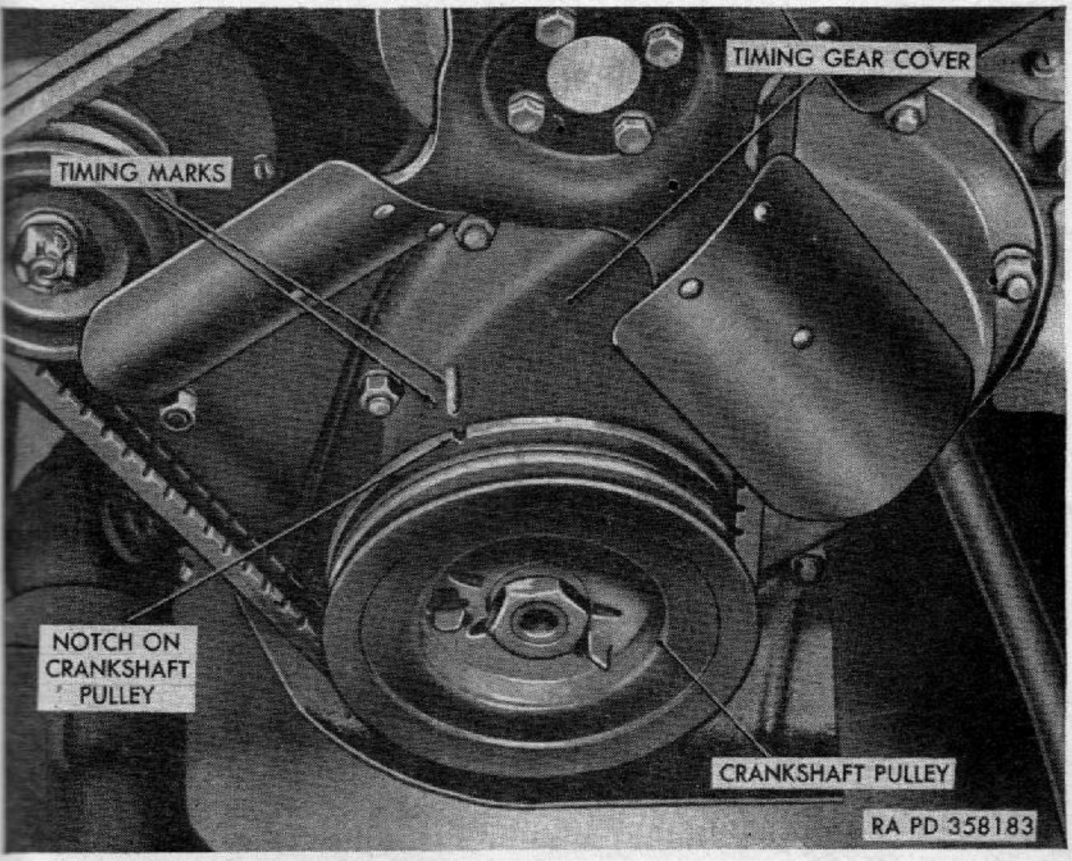


Figure 58. Timing marks on crankcase pulley.

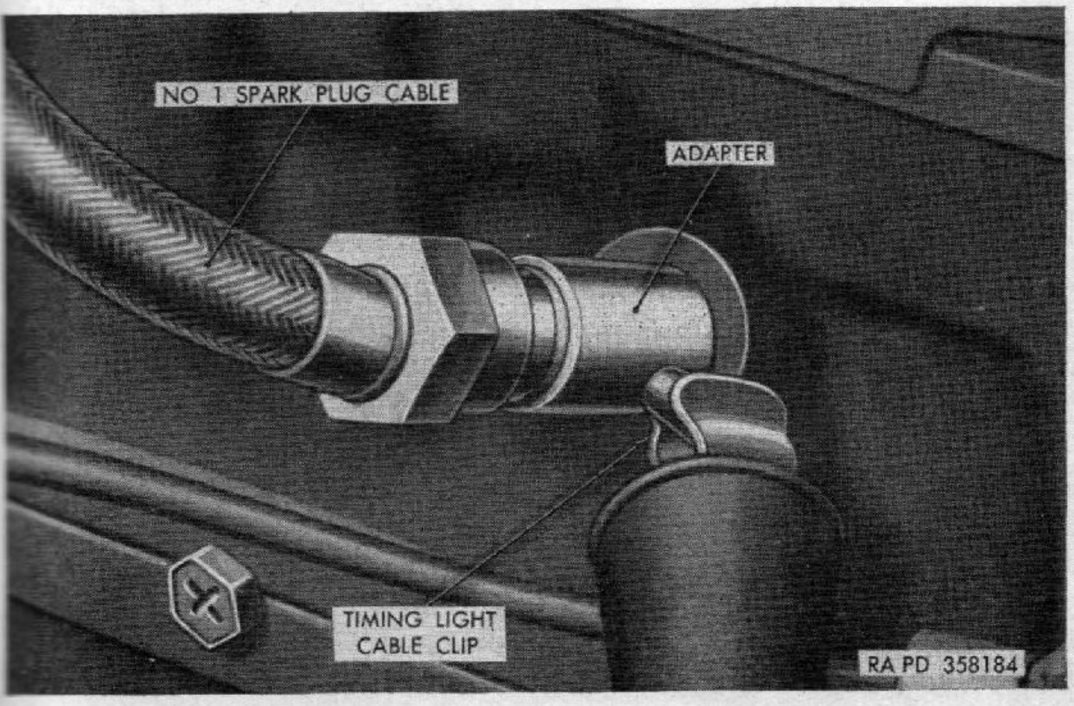


Figure 59. Timing light adapter installed.

(5) Remove spark plug cable from No. 1 spark plug. Thread adapter (fig. 59) onto spark plug; then connect No. 1 spark plug cable to adapter.

(6) Connect one terminal of the timing light to the adapter (fig. 59) and connect the other terminal to the ground.

(7) Start the engine and run at a slow idle. Direct beam of timing light toward the timing marks (fig. 58). Timing light flashes make the timing mark on the crankshaft pulley (fig. 58) appear stationary. Loosen distributor mounting screw (fig. 57) and turn distributor housing clockwise or counterclockwise as necessary to synchronize flashes of the timing light with the timing marks on the crankshaft pulley. When the timing mark is alined, tighten distributor mounting screw.

113. Distributor and Ignition Coil Assembly

a. Distributor Breaker Point Adjustment.

(1) Remove six screws with internal-tooth lock washers securing distributor cover (fig. 57) and remove distributor cover. Pull distributor rotor (fig. 60) off distributor cam. Clean the distributor breaker points, using a contact point dresser. If distributor breaker points are badly pitted or burred, replace them (*b* below).

(2) Turn the engine over, with the ignition switch off, in small stages by intermittently operating starter until distributor cam (fig. 61) comes to rest with breaker lever pad (fig. 61) on the flat of the distributor cam (points closed). Using a contact spring gage (fig. 61), check the amount of pull required to open the distributor breaker points. If not within 17 to 21 ounces, adjust breaker arm spring tension by bending breaker arm spring slightly.

(3) Turn engine over until breaker level pad comes to rest on the high point of the distributor cam (fig. 62) (points open). Measure distributor breaker point opening with a feeler gage (fig. 62). If the gap does not measure 0.020 inch, loosen clamp screw (fig. 62) and turn adjusting screw (fig. 62) to obtain correct opening. Tighten clamp screw. Install distributor rotor and install distributor cover, securing with six screws.

b. Distributor breaker point replacement (fig. 60).

(1) *Removal.* Remove six screws securing distributor cover (fig. 57) and remove distributor cover. Pull distributor rotor off distributor cam. Remove clamp screw to remove stationary breaker point support from breaker plate. Loosen terminal screw on distributor breaker arm terminal, remove ignition coil and capacitor cables, and lift out distributor breaker arm.

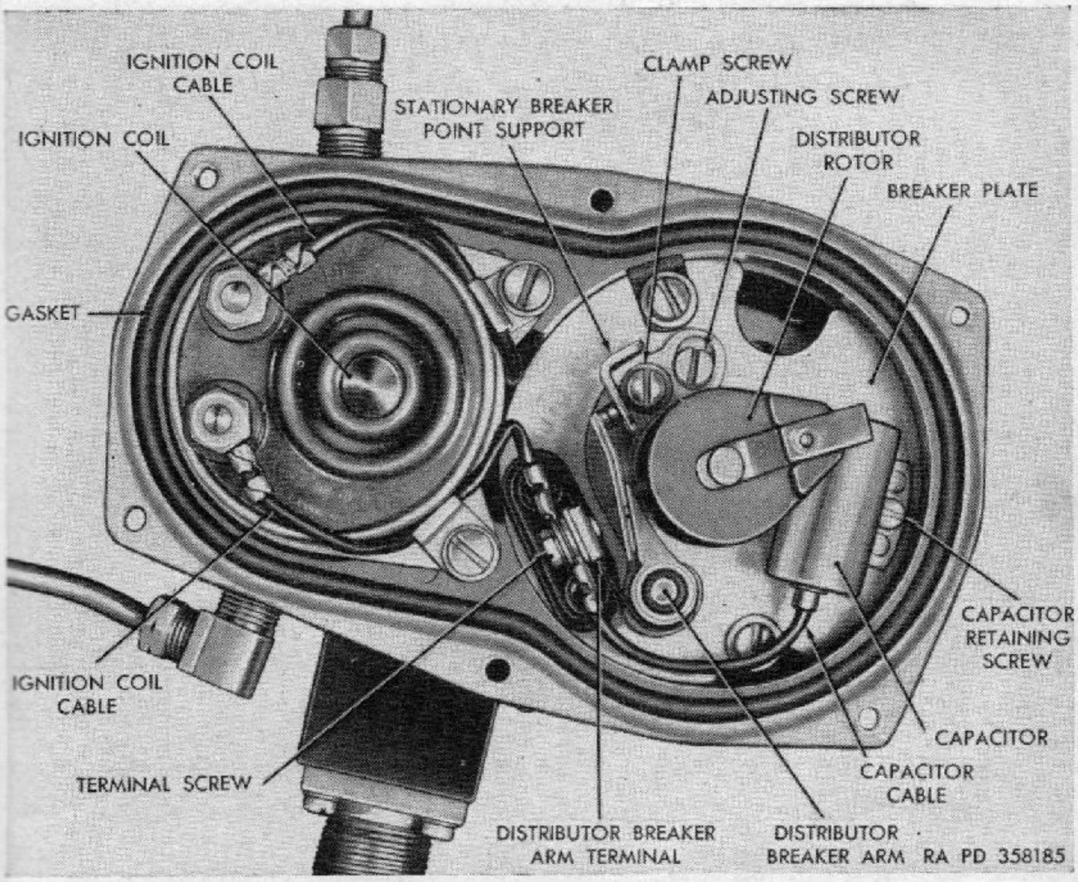


Figure 60. Distributor and ignition coil assembly—distributor cover removed.

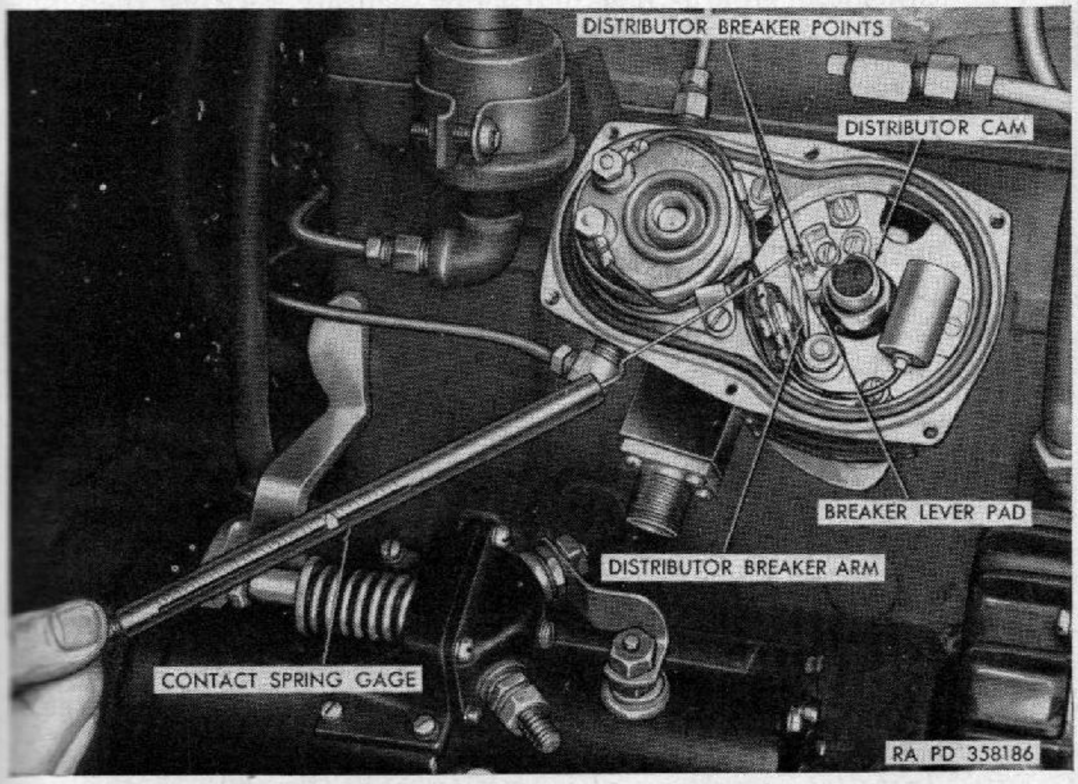


Figure 61. Testing distributor breaker arm spring tension.

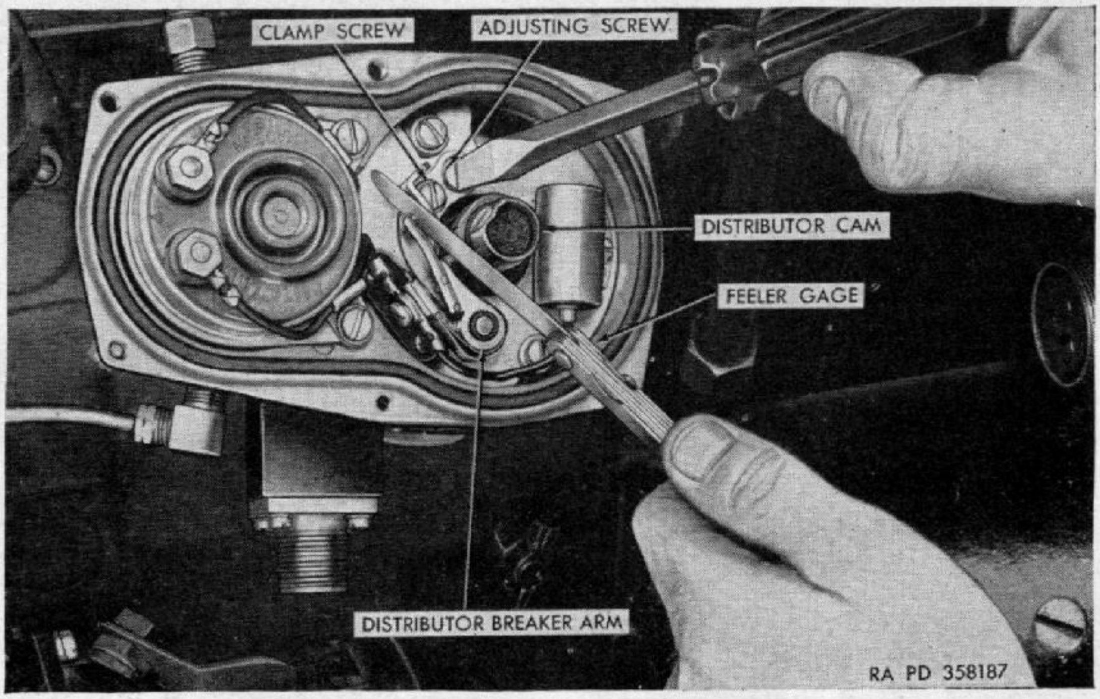


Figure 62. Adjusting distributor breaker points.

(2) *Installation.* Position slotted hole in stationary breaker point support over the adjusting screw, and place and tighten the clamp screw in the other hole. Place the distributor breaker arm on the pivot part of the breaker plate and slip the slot of the breaker arm spring over the loosened terminal screw, and tighten terminal screw securely. Adjust distributor breaker points (*a* above) and install distributor cover.

c. Capacitor Replacement (fig. 60).

(1) *Removal.* Remove the six screws securing distributor cover (fig. 57) and remove distributor cover. Remove the capacitor retaining screw and loosen the terminal screw on the breaker arm spring terminal and remove capacitor cable. Lift out capacitor.

(2) *Installation.* Position the capacitor on the breaker plate and secure with capacitor retaining screw. Place capacitor cable on breaker spring terminal and secure with terminal screw. Install distributor cover and secure with six screws.

d. Ignition Coil.

(1) *Removal.* Remove six screws securing distributor cover (fig. 57) and remove distributor cover. Remove nuts and washers securing the ignition coil cables to the terminals on the ignition coil (fig. 60). Remove the two screws and washers securing the ignition coil and cable clips to the distributor housing and lift out the ignition coil (fig. 63).

(2) *Installation.* Place the ignition coil (fig. 63) in the distributor housing and install the two screws, washers, and

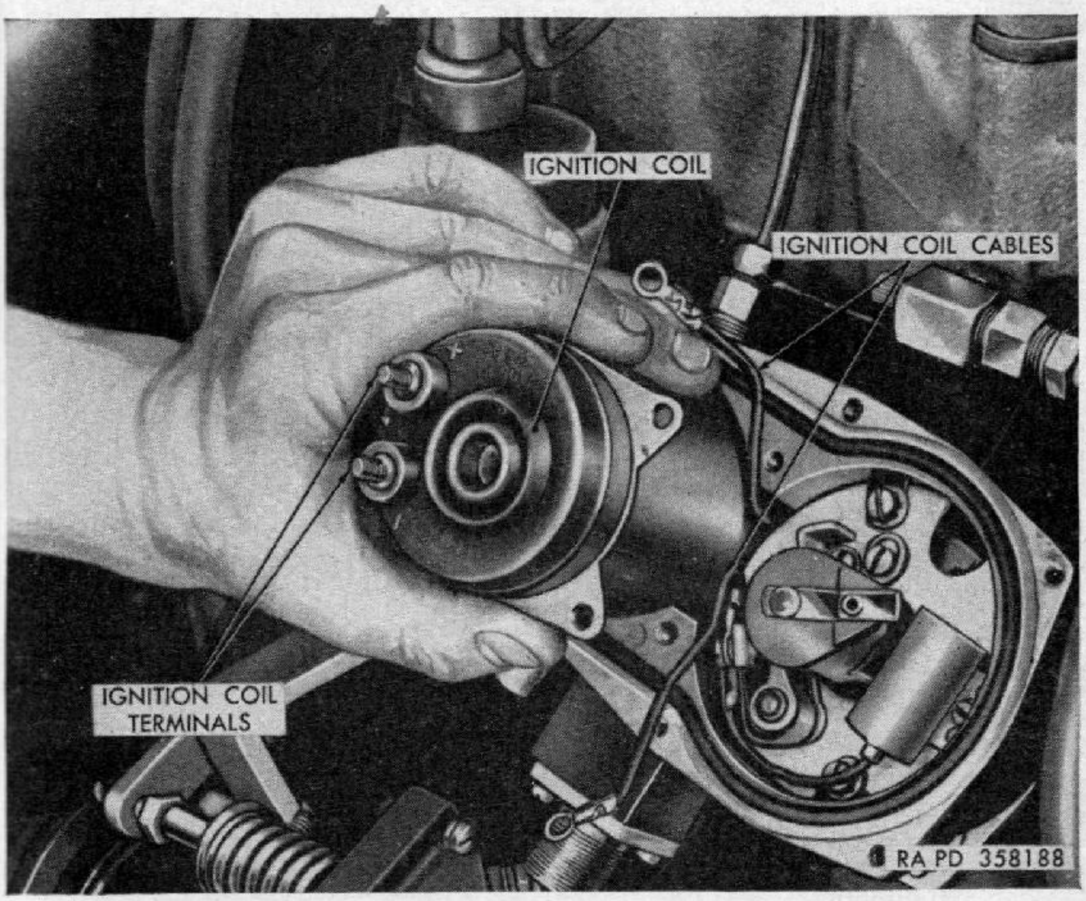


Figure 63. Removing ignition coil.

cable clips, placing ignition coil cables in cable clips, and tighten screws securely. Place ignition coil cables on terminals on ignition coil (fig. 63) and secure with washers and nuts, on each terminal. Install distributor cover and secure with six screws.

e. Distributor and Ignition Coil Assembly Removal (fig. 57).

(1) Loosen the terminal nuts securing the spark plug cables to the distributor cover and remove the spark plug cables. Remove distributor vent line and ignition switch cable from distributor housing.

(2) Remove six screws attaching distributor cover to distributor housing and remove distributor cover. Mark or note position of distributor rotor (fig. 60) to facilitate installation of the replacement unit. Remove the distributor mounting screw and lift the distributor and ignition coil assembly from the engine.

f. Distributor and Ignition Coil Assembly Installation.

(1) Remove the cover fromthe replacement distributor and ignition coil assembly and place the distributor rotor (fig. 60) in the same position as on the unit removed. Insert the dis-

tributor and ignition coil assembly into the hole in the engine engaging the driving slot and seat the unit. Install the distributor mounting screw (fig. 57) but do not tighten. Set the ignition timing (par. 112) and tighten the distributor mounting screw. Install the distributor cover and secure with six screws.

(2) Connect the distributor vent line (fig. 57) and the ignition switch cable. Install the spark plug cables (fig. 57) in the correct position and tighten terminal nuts.

114. Spark Plugs and Spark Plug Cables

a. Spark Plug Cables.

(1) *Removal.* Loosen the terminal nuts (fig. 57) securing the spark plug cables to the spark plugs (fig. 25) and distributor cover (fig. 57). Remove spark plug cables from cable clips on intake valve cover (fig. 25) and remove the spark plug cables.

(2) *Installation.* Attach the spark plug cables to the distributor cover (fig. 57) and tighten the terminal nuts.

Note.—Care should be exercised when tightening the terminal nuts on the spark plug cables so as not to damage the threads by overtightening.

Install spark plug cables in the cable clips on the intake valve cover (fig. 25) and attach spark plug cables to the spark plugs (fig. 25) making sure the firing sequence is correct.

b. Spark Plugs.

(1) *Removal.* Loosen the terminal nuts on the spark plug cables and remove the spark plug cables from all four spark plugs (fig. 25). Using a deep socket of the correct size, remove the spark plugs and gaskets from the spark plug openings in the cylinder head.

(2) *Cleaning and adjustment.* Clean the spark plugs, using suitable sand-blast cleaning equipment. If electrodes or porcelain insulator are badly burned, install new spark plugs ((3) below). Using a round feeler gage, check the gap between electrodes. If the gap is not 0.030 inch, adjust gap by bending grounded (side) electrode only. Do not bend center electrode.

(3) *Installation.* Install spark plugs with gaskets in openings in cylinder head and tighten securely. Install spark plug cables on spark plugs, making certain cables from the four spark plugs are inserted in the distributor cover as shown in figure 57. Tighten terminal nuts securely.

Section XI. STARTING SYSTEM

115. Description and Data

a. Description

(1) *General.* The starting system circuit (fig. 64) consists of the source of power (batteries), starter switch, starter, starter switch pedal with connecting linkage, and connecting electrical cables. The outlet receptacle, furnished as part of the winterization kit, is considered a part of the starting system when a slave battery or an outside power source is used to assist in starting the engine. The starting system circuit is shown in figure 64. The starter drive pinion is shifted into engagement with the flywheel ring gear teeth and the starter switch contacts are closed manually by operation of the starter switch pedal (fig. 6).

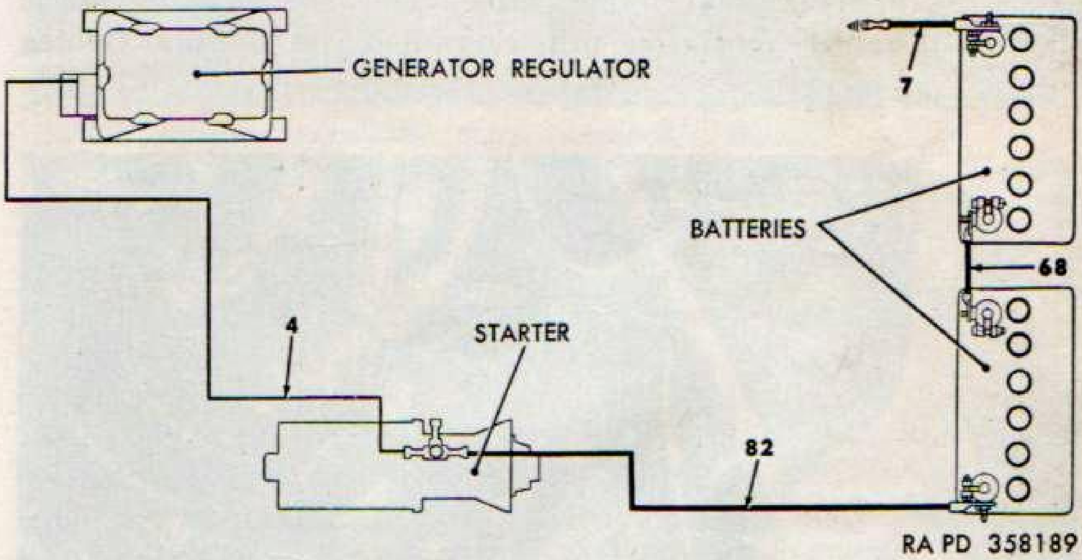


Figure 64. Starting system circuit.

(2) *Starter.* The starter (fig. 66) is a completely sealed waterproof unit mounted on the right side of the engine. The starter switch (fig. 66) is an integral part of the starter and is mounted on the top of the starter assembly. The starter is a four pole, four brush unit with three field coils connected in series and one shunt. The starter is equipped with an overrunning clutch type drive which automatically disengages when the engine is started. The bearings are prelubricated at assembly and require no attention.

b. Data.

Manufacturer	Auto-Lite
Model	MCZ-4001UT
Voltage	24
Cranking speed	160 rpm
Drive	manual
Switch	integral with starter

116. Starter

a. Removal. Remove terminal nut (fig. 65) and remove battery cable, generator cable, and outlet receptacle cable (if installed) from starter switch terminal. Remove cap screw and lock washer securing front of starter to starter support (fig. 66). Remove two safety nuts securing starter to flywheel housing and remove starter and gasket.

b. Installation. Install starter on flywheel housing with a new gasket and secure to flywheel housing with two safety nuts. Secure front of starter to starter support (fig. 66) with cap screw and lock washers. Place distributor cable, battery cable, and outlet receptacle cable (if installed) on starter switch terminal (fig. 65) and tighten terminal nut securely.

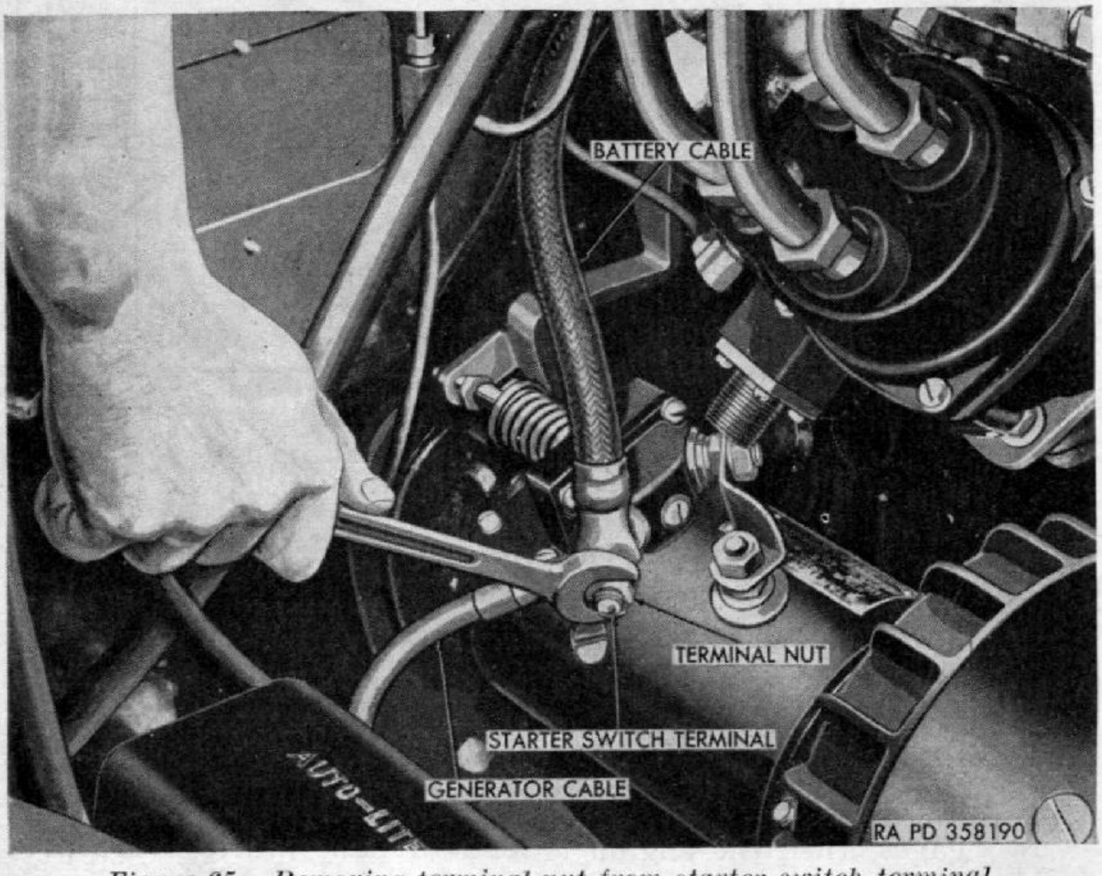


Figure 65. Removing terminal nut from starter switch terminal.

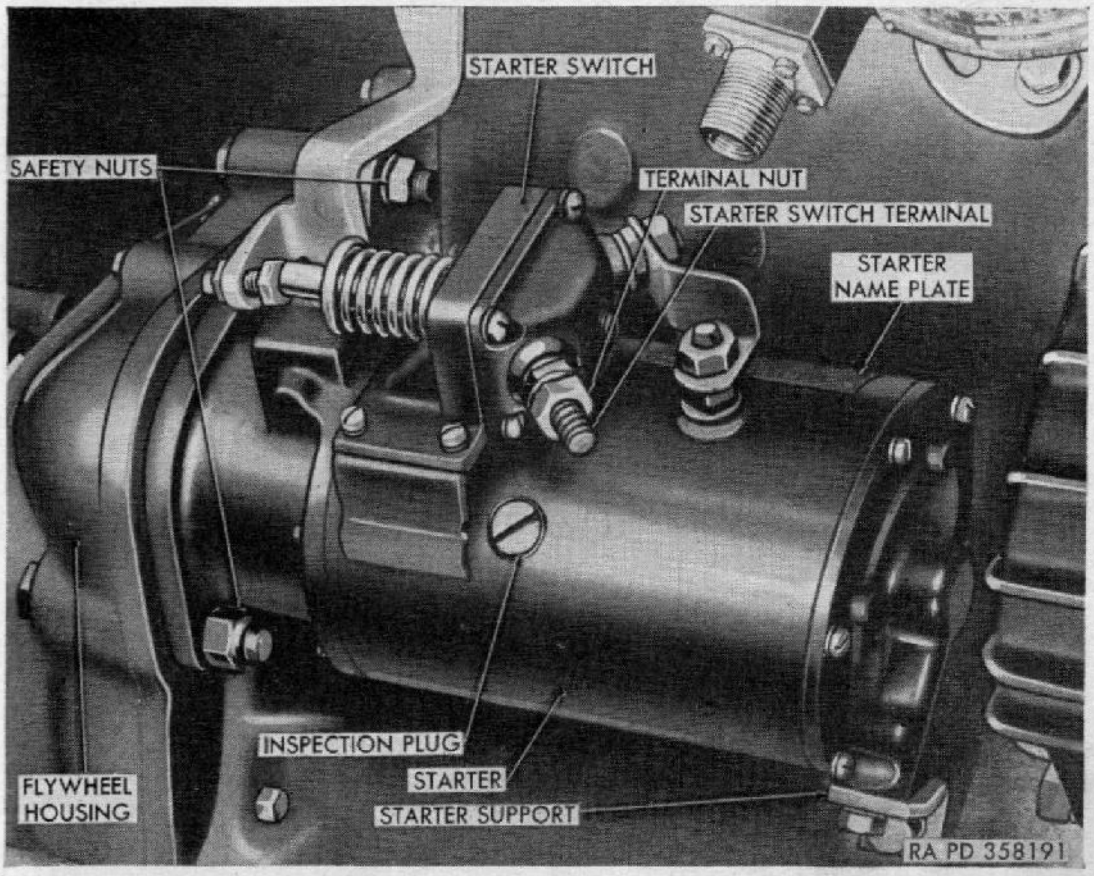


Figure 66. Starter installed on engine.

Section XII. GENERATING SYSTEM

117. Description and Data

a. Description.

(1) *General.* The generating system circuit (fig. 67) consists of the generator, generator regulator, power source (batteries), and interconnecting cables. The generating system is sealed and completely waterproof for submersion under water. The generating system is a 24 volt, single wire, ground return system and its purpose is to replace the current used in the batteries.

(2) *Generator.* The generator (fig. 68) is a two brush, 25 ampere, 24 volt unit specially designed for underwater operation. The generator is mounted on the right side of the engine and is driven by two drive belts, in conjunction with the water pump, from the crankshaft. Generator mounting permits positioning of generator to provide proper drive belt tension. All external cable connections are made through a three prong, plug and receptacle type connectors. The commutator end bearing is packed at assembly with heat resisting

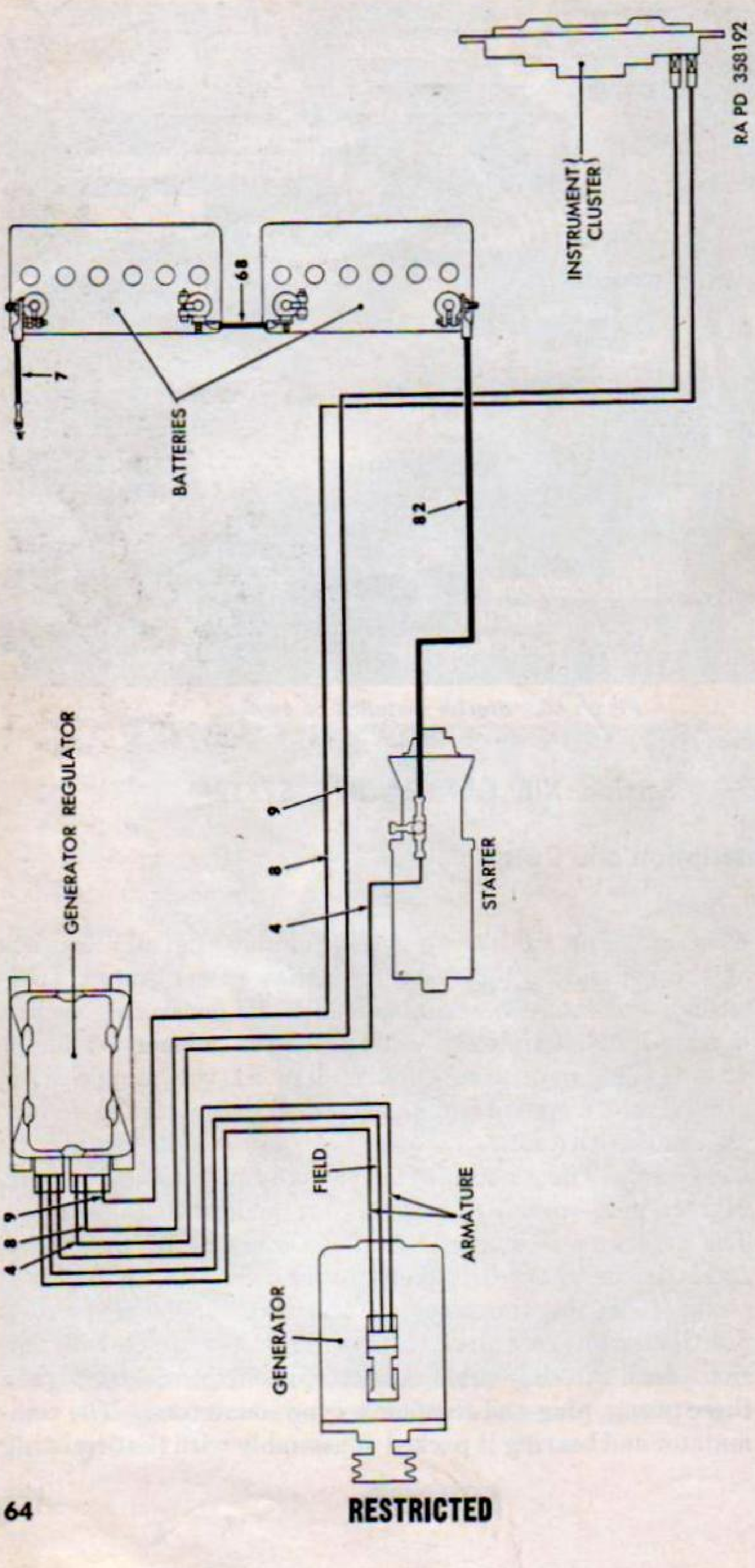


Figure 67. Generating system circuit.

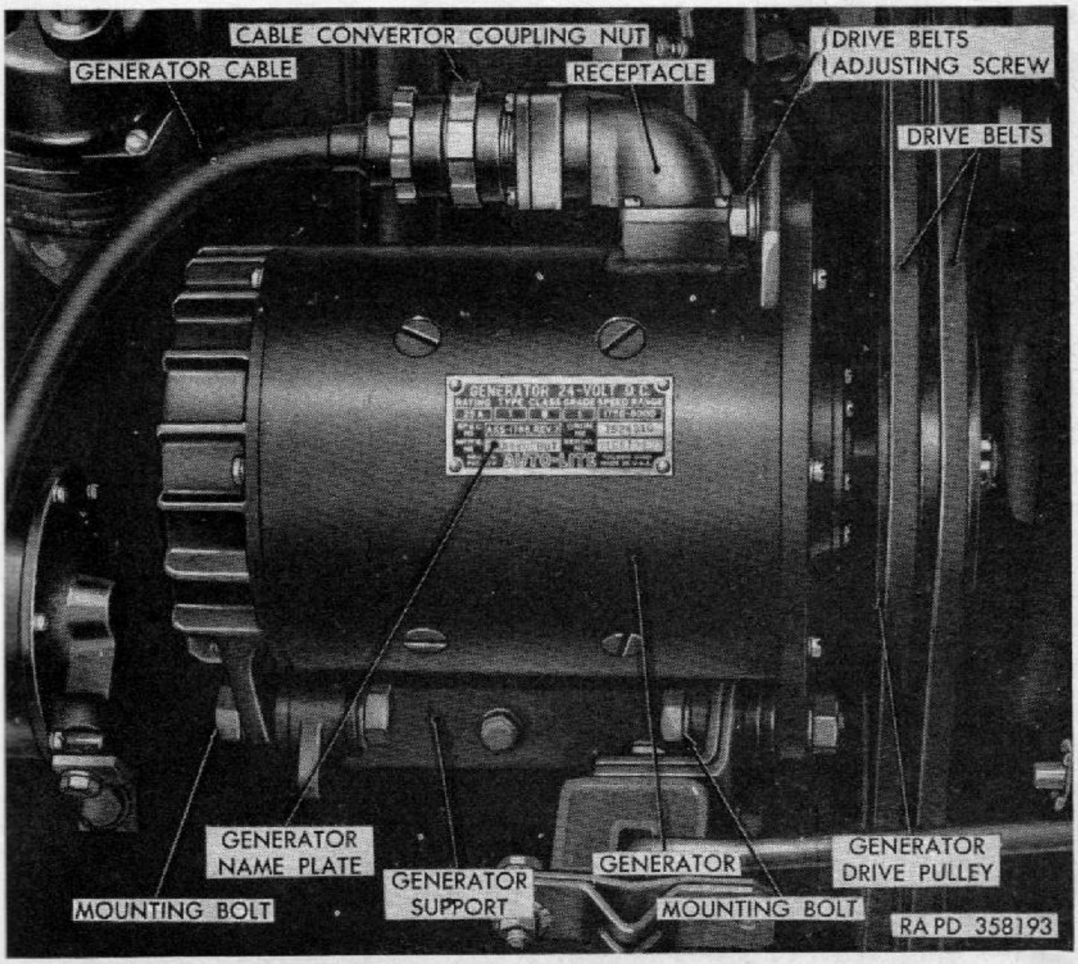


Figure 68. Generator installed on engine.

grease and requires no attention between rebuilds. The drive end bearing is lubricated by a pick-up gear, which rotates in a chamber filled with lubricating oil. This chamber should be full when installed and requires no further attention.

(3) *Generator regulator.* The generator regulator (fig. 69) consists of three units; the voltage regulator, current regulator, and circuit breaker. The voltage regulator unit protects the batteries by controlling the voltage and prevents overcharging. The current regulator unit controls the amperage output and prevents generator damage due to overload. The circuit breaker unit is an automatic switch controlling the flow of current to all electrical accessories. All three units are enclosed in a watertight housing.

b. Data.

Generator:

Controlled output	25 amp
Ground polarity	neg
Manufacturer	Auto-Lite
Voltage	24

Generator regulator:

Amperes	25
Ground polarity	neg
Manufacturer	Auto-Lite
Voltage	24

118. Generator

a. Removal. Remove the drive belts adjusting screw (fig. 68) and swing generator up toward engine. Remove both drive belts from generator drive pulley. Unscrew cable connector coupling nut at receptacle with wrench 41–W–3249–900 (fig. 70) and pull generator cable plug out of receptacle. Remove the two mounting bolts from the generator support and remove the generator.

b. Installation. Place the generator on the generator support (fig. 68) and install the two mounting bolts. Swing the generator up toward the engine and install the two drive belts over the generator drive pulley. Pull the generator away from the engine, install the drive belt adjusting screw, and adjust the drive belts (par. 124). Plug the generator cable in the receptacle on top of the generator and secure with the cable connector coupling nut using wrench 41–W–3249–900.

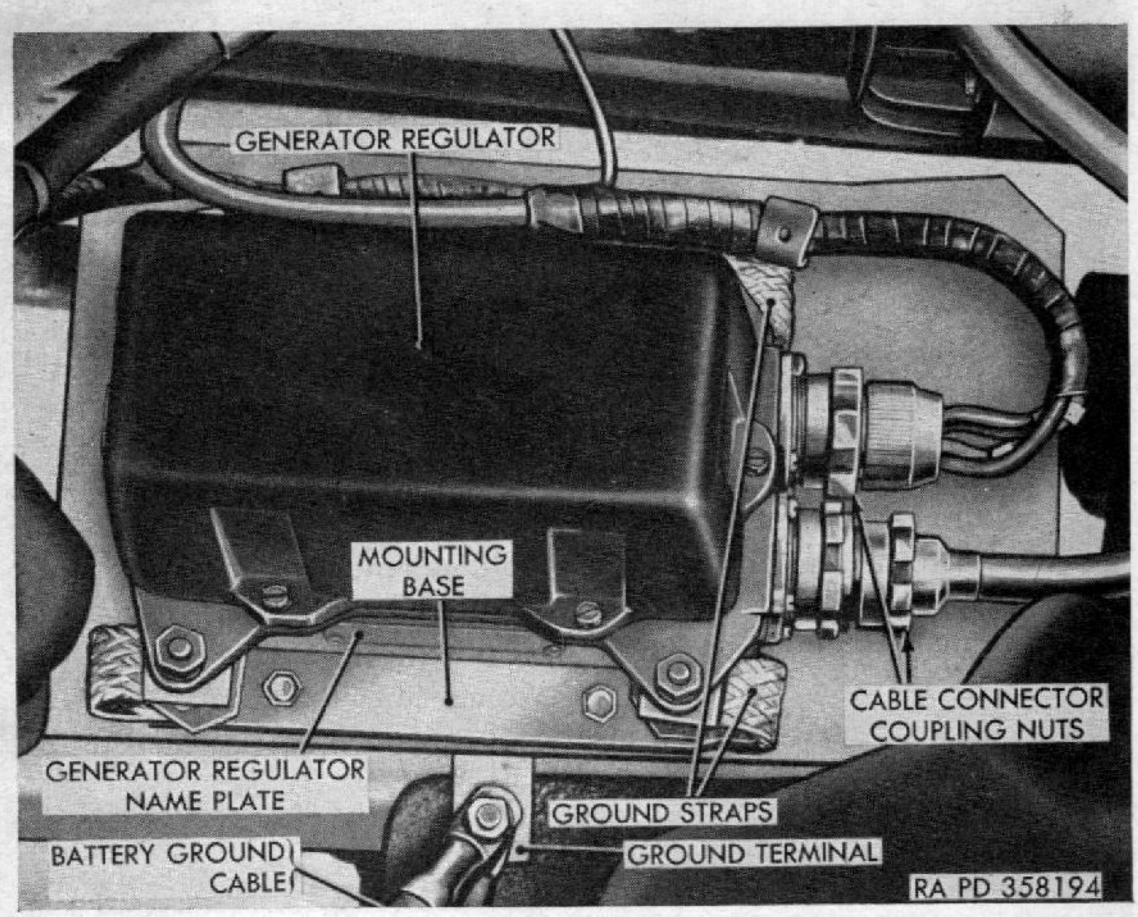


Figure 69. Generator regulator installed.

119. Generator Regulator

a. Removal. Using wrench 41–W–3249–900 (fig. 70), unscrew the two cable connector coupling nuts (fig. 69) and pull out the coupling plugs. Remove the four nuts and flat washers securing generator regulator to mounting base and remove generator regulator.

b. Installation. Place the generator regulator (fig. 69) in position on mounting studs, making sure all four ground straps and external tooth lock washers are in place. Secure generator regulator to mounting base with four nuts and flat washers. Connect coupling plugs and tighten the cable connector coupling nuts securely with wrench 41–W–3249–900 (fig. 70).

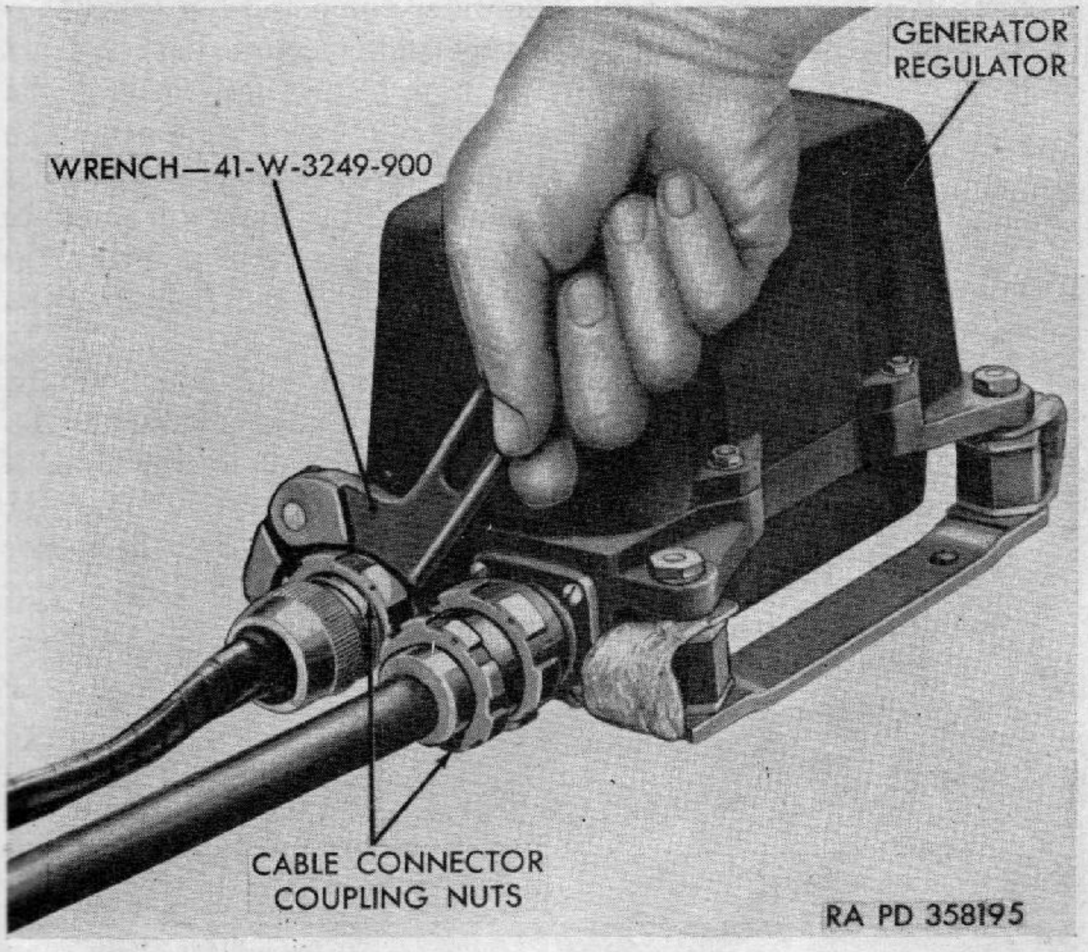


Figure 70. Tightening cable connector coupling nut with wrench 41–W–3249–900.

Section XIII. COOLING SYSTEM

120. Description and Data

a. Description.

(1) *General.* The cooling system (fig. 71) is a sealed pressure type and consists of the following units: water pump, fan, radiator, drive belts, thermostat, and connecting hoses.

Water is drawn from the bottom of the radiator by the action of the water pump and is circulated through the engine and returned to the radiator. Air drawn through the radiator core by the fan and the motion of the vehicle, cools the water in the radiator to maintain correct operating temperature.

(2) *Radiator.* The radiator (fig. 71) is of the cellular type construction and utilized a pressure filler cap which maintains a pressure in the cooling system up to 4½ psi. The radiator is mounted in a vertical position at the front of the engine and is equipped with a drain valve to facilitate draining.

(3) *Water pump and fan.* The water pump and fan (fig. 71) is of the centrifugal impeller type and is mounted at the front of the cylinder block. The four bladed fan fastens to a double sheave drive pulley. The purpose of the water pump is to force cooling water through the cylinder block, cylinder head, and radiator. A bypass hose from the water pump to the cylinder block prevents the water from entering the radiator when the engine is cold and the thermostat is closed.

(4) *Thermostat.* The thermostat is located in the front portion of the cylinder head under the water outlet elbow (fig. 71). The purpose of the thermostat is to regulate the flow of coolant in accordance with engine temperatures. When the engine is cold, the thermostat valve is closed; as the engine gradually heats up, the valve begins to open. When engine operating temperature is at normal (160° to 180° F.), the thermostat is fully open to permit full circulation.

b. Data.

Radiator:	
Capacity	11 qt
Filler cap	pressure type 4½ psi
Manufacturer	Blackstone
Water pump and fan:	
Drive	belt
Fan	four blade 15-in diam
Location	front of cylinder block
Type	centrifugal
Drive belts:	
Angle	38 deg
Width	⅝-in
Type	vee-wedge cogged
Thermostat:	
Fully open	175° F.
Location	water outlet elbow
Opening Range	148° to 155° F.

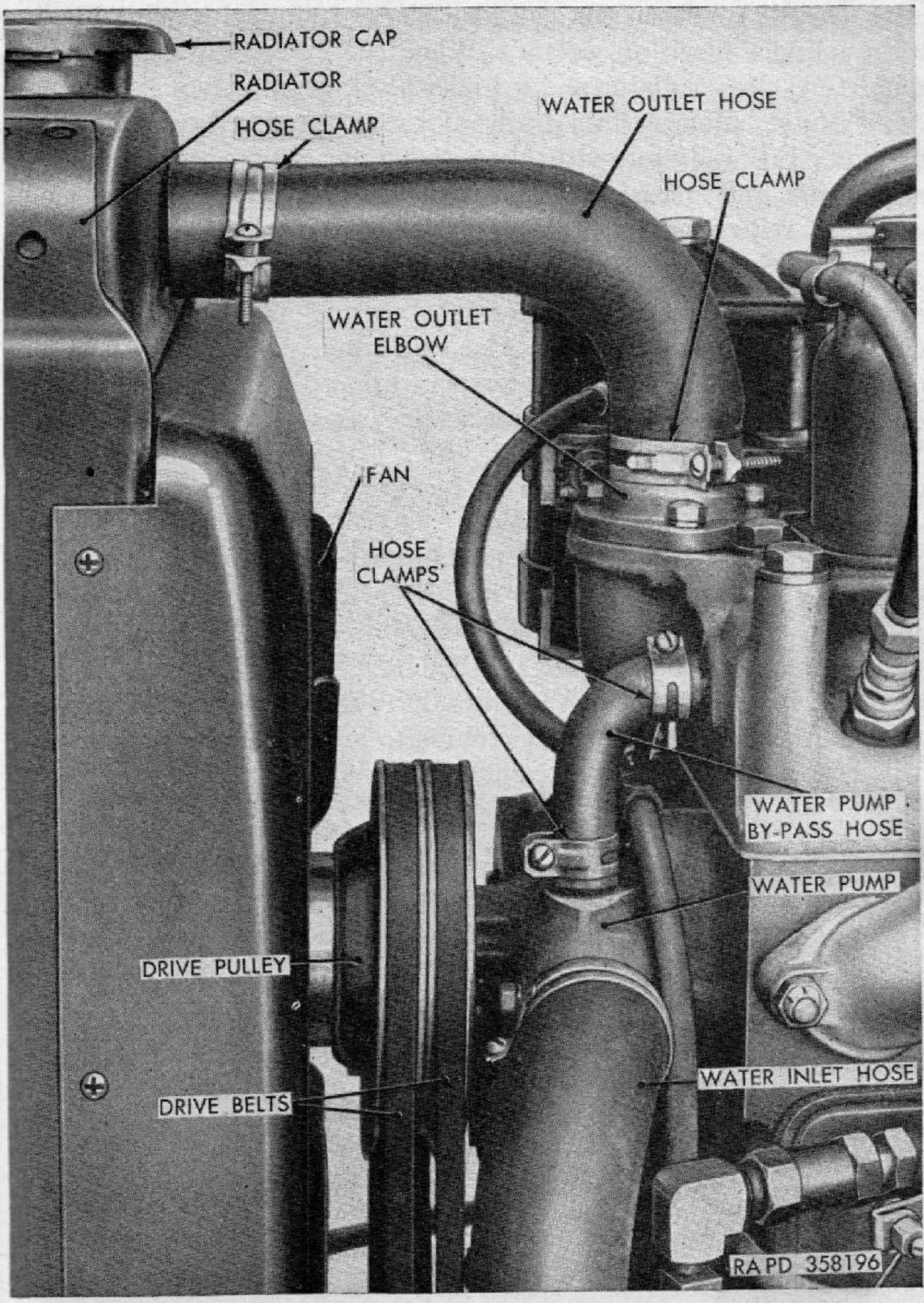


Figure 71. Cooling system.

121. Cooling System Maintenance

a. Draining. To drain the cooling system, first open hood (par. 216) and remove the radiator cap to relieve pressure. Place a container under the radiator, if necessary, and open the radiator drain valve (fig. 72). Open the cylinder block drain valve (fig. 72) to drain cylinder block of coolant. When cooling system has drained completely, close radiator and cylinder block drain valves.

b. Filling. Make certain drain valves are closed and remove radiator cap. Fill radiator with clean water or antifreeze solution to meet lowest anticipated temperature. Fill to a level slightly below bottom of radiator filler neck. Start engine to expell air in system and fill system again.

Caution.—Do not pour water into cooling system when engine temperature is above 200° F. Also cold water poured into the cooling system, regardless of engine temperature, will cause the thermostat to close and not allow the engine water passages to completely fill. Whenever filling system with cold water, always run the engine until normal operating temperature is reached; then add water to fill cooling system.

c. Air Suction Test. The air suction test is used to determine if air is entering the coolant, possibly due to low coolant level in the radiator, leaky water pump, or loose hose connections. To make test, fill cooling system to bottom edge of filler neck in radiator. Replace pressure type radiator cap with a plain radiator cap and tighten securely. Attach length of rubber tubing to lower end of overflow pipe (this connection must be airtight). Run engine, with transmission

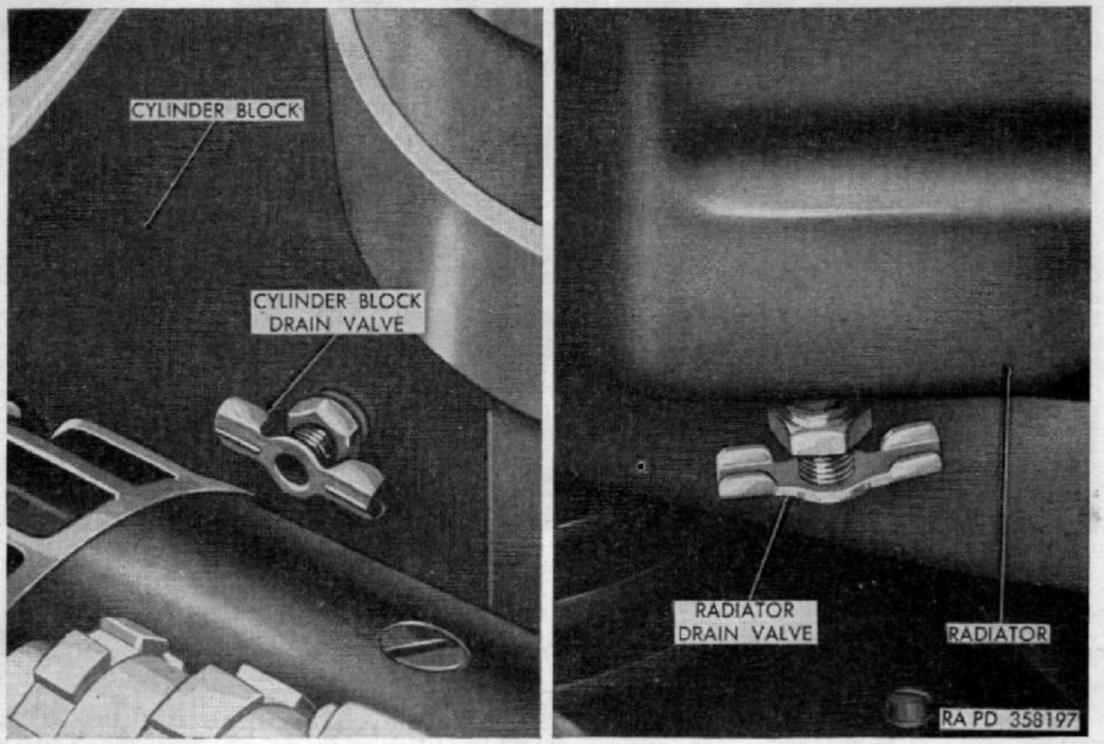


Figure 72. Cooling system drain valves.

in neutral, at a moderate speed until warmed up. Place other end of rubber tubing in a glass container of water, and without changing engine speed, watch for bubbles in water. Continuous appearance of bubbles indicates that air is entering system. Correct as necessary.

d. Exhaust Gas Leakage Test. The exhaust gas leakage test is used to determine if gas is entering into the coolant, possibly due to a leaky cylinder block, cylinder head, or cylinder head gasket.

Note.—Make this test with the engine cold.

Remove drive belts (par. 124). Open radiator drain valve (fig. 72) and drain until coolant level is below the level of water outlet elbow (fig. 71).

Note.—This may be determined by loosening the three cap screws securing water outlet elbow.

Remove water outlet elbow and fill cylinder head with coolant until level of coolant is level with top of cylinder head. With transmission in neutral, start engine, accelerate the engine quickly several times, and watch for bubbles in water. Appearance of bubbles indicates leakage which must be corrected. Replace leaky cylinder head gasket (par. 91); report other causes to ordnance maintenance personnel.

e. Cleaning and Flushing.

(1) *Cleaning.* Run engine at moderate speed to move particles of rust in system and then drain cooling system (*a* above). Close drain valves and fill cooling system (*b* above) with specified cleaning compound. Install radiator cap and operate engine as directed for prescribed solution. Stop engine and completely drain cooling system (*a* above). Repeat if necessary.

(2) *Flushing.* Completely drain cooling system (*a* above). Close drain valves, fill system with clean water, and start engine. Open drain valve in radiator (fig. 72) and while water is draining from drain valve, run fresh, clean water in at top of radiator. Do this until water runs clean. To reverse flush the cooling system, drain completely (*a* above), close drain valves, and remove hose from water outlet elbow.

Note.—If thermostat is installed, it must be removed (par. 124).

Stuff rag or other plug into open end of water outlet hose, and with a hose force water into cylinder head until water comes out top of radiator. When water runs clean, tighten hose on water outlet elbow and fill cooling system (*b* above).

Note.—Addition of corrosion inhibitor compound in cooling system will prevent future formation of rust on scale.

122. Radiator

a. Removal.

(1) Drain cooling system (par. 121*a*). Remove grille as outlined in paragraph 96.

(2) Loosen hose clamps on water inlet and water outlet hoses (fig. 71) and pull hoses from connections on radiator. Carefully lift radiator off radiator support rods (fig. 42), making sure that fan does not rub fins of radiator core, and lift out radiator.

b. Installation.

(1) Position radiator over fan, being careful not to damage fins of radiator core, and insert each bottom end of radiator in radiator support rods (fig. 42). Connect water inlet and water outlet hoses (fig. 71) to connections on radiator and tighten hose clamps securely.

(2) Install grille as outlined in paragraph 97. Fill cooling system (par. 121 *b*).

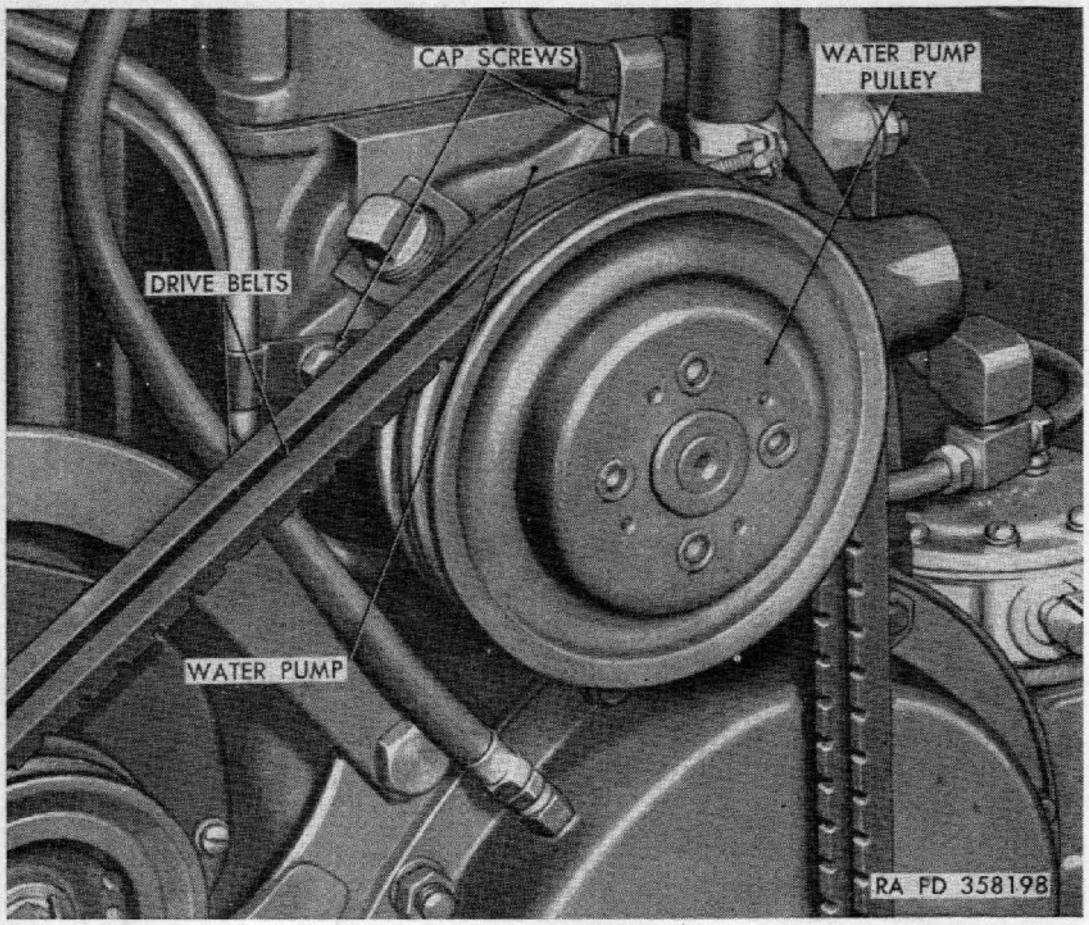


Figure 73. Water pump installed.

123. Water Pump and Fan

a. Removal.

(1) Open hood (par. 216) and drain cooling system (par. 121*a*). Lower and remove grille (par. 96). Remove radiator (par. 122*a*). Remove drive belts (par. 124).

(2) Disconnect water pump bypass hose (fig. 71) from water pump by loosening hose clamps and pulling hose off fitting. Remove the four cap screws and lock washers securing water pump to cylinder block and remove water pump and gasket.

(3) If water pump pulley is to be replaced, proceed as follows: place water pump in a vise equipped with jaw protectors, and remove four cap screws and lockwashers securing fan to water pump and remove fan. Install puller 41–P–2908–240 (fig. 74) on pulley by tightening cap screws of puller into holes in water pump pulley and remove pulley from water pump shaft.

b. Installation.

(1) If water pump pulley was removed ((3) above), place water pump pulley over water pump shaft, and drive onto shaft

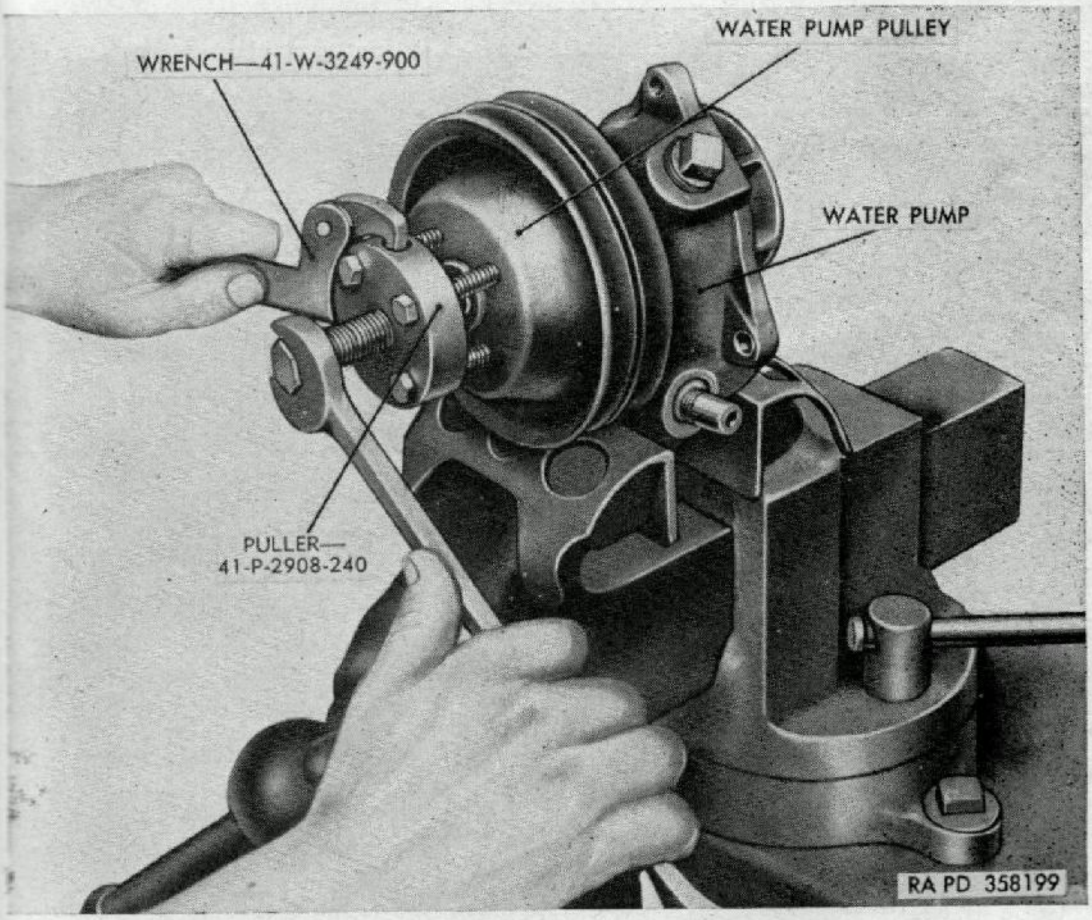


Figure 74. Removing water pump pulley with puller 41–P–2908–240.

with a soft hammer. Position fan on water pulley pump and secure with four cap screws and lock washers.

(2) Position water pump on cylinder block with a new gasket and secure with four cap screws and lock washers. Install water pump bypass hose on fitting on water pump and tighten hose clamp.

(3) Install and adjust drive belts (par. 124). Install radiator (par. 122*b*). Install grille (par. 97). Fill cooling system (par. 121*b*).

124. Drive Belts

(fig. 75)

a. Adjustment. Open hood (par. 216). Loosen the drive belts adjusting screw (fig. 68) and move generator away from or closer to the engine until the drive belts have a measured deflection of three-quarters of an inch between a straightedge placed over belts from water pump pulley to generator drive pulley. Then tighten drive belt adjusting screw.

b. Removal. Open hood (par. 216). Loosen the drive belts adjusting screw (fig. 68) and move the generator toward the engine as far

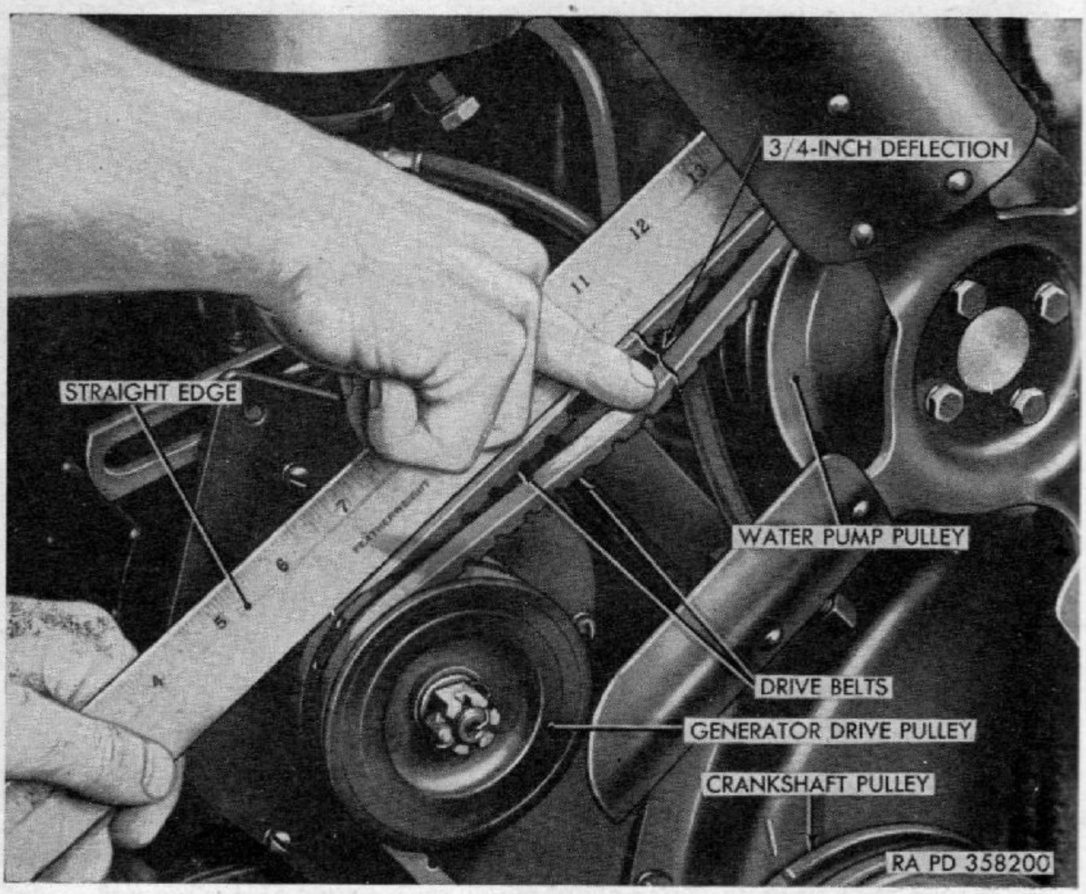


Figure 75. Adjusting drive belts.

as it will go; then tighten drive belt adjusting screw. Working with one belt at a time, slip edge of drive belt over edge of generator drive pulley first, then remove drive belt from water pump pulley and crankshaft pulley and remove by lifting over fan and out of vehicle. Remove the second drive belt by first rotating it into groove of first drive belt; then proceed as above.

c. Installation. Install drive belts (fig. 75), working with only one at a time, over the fan and into the first groove of the crankshaft pulley and water pump pulley. Work edge of drive belt over edge of generator drive pulley until it fits in groove. Work or rotate drive belt into second groove of all three pulleys; then install second drive belt.

125. Thermostat

a. Removal. Drain cooling system (par. 121*a*). Remove three cap screws and lock washer securing water outlet elbow (fig. 71) to cylinder head and swing water outlet elbow attached to water outlet hose to one side. Remove gasket. Lift thermostat from opening in cylinder head.

b. Installation. Check the condition of the gasket surfaces of the water outlet elbow and cylinder head and place new thermostat in opening in cylinder head. Place gasket on cylinder head and position water outlet elbow (fig. 71) on cylinder head and gasket. Secure with three cap screws and lock washers. Run engine to test for leaks.

Section XIV. BATTERY AND LIGHTING SYSTEM

126. Description and Data

a. Description.

(1) *General.* The batteries and lighting system circuit (fig. 76) is a 24-volt, submersible type system. Cable connectors at lights are made through bayonet type connectors, held together by interlocking sleeves. Rubber grommets inside the sleeves protect the connections from moisture. All light circuits are controlled from the light switch (G, fig. 6) on the instrument panel. The lighting system, as is the complete electrical system, is protected by the circuit breaker in the voltage regulator. All electrical cables are identified by identification tags at each end. Refer to wiring diagram (fig. 87) for cable identification.

(2) *Batteries and battery cables* (fig. 78). Two 12-volt, lead and acid type batteries connected in series, supply the 24-volt primary current for operation of the vehicle. These batteries will not be damaged by underwater operation and are equipped with a special plug, which, when sealed properly,

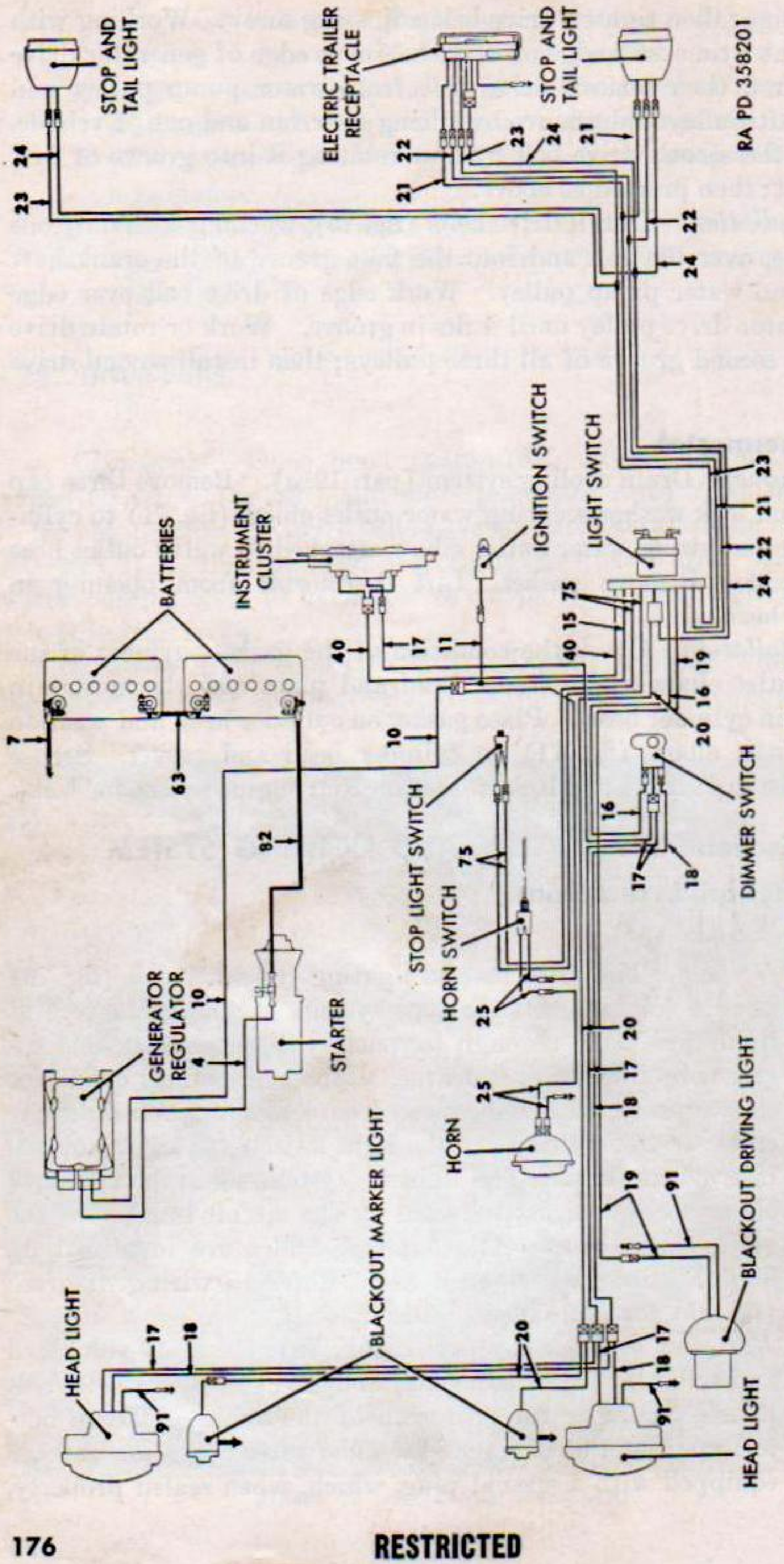


Figure 76. Batteries and lighting system circuit.

prevents entrance of water into the battery cells. Battery terminals are waterproofed by a thick coating of grease, after installation. Waterproof cables are used to connect the batteries to the starter. The batteries (fig. 77) are located in a battery compartment just forward of the windshield on the right side of the vehicle.

(3) *Service headlights* (fig. 80). The service headlights are mounted in the radiator grille. These are waterproof, double filament, sealed beam unit type with headlight beam selected by a foot-operated dimmer switch. Control is from the light switch (G, fig. 6) on the instrument panel.

(4) *Blackout driving light* (fig. 83). The blackout driving light is located on the forward section of the left front fender. This blackout driving light is a waterproof, sealed beam type. Operated by the light switch (G, fig. 6), the blackout driving light furnished a diffused, low-intensity light beam to be used when the tactical situation does not permit use of service headlights.

(5) *Stop and taillights* (fig. 86). The stop and taillights are mounted at the rear corners of the vehicle body and consist of two waterproof assemblies right-hand and left-hand. The right-hand unit incorporates a blackout stop lamp in the upper portion and a blackout taillamp in the lower portion. The left-hand unit incorporates a combination stop and taillamp in the upper portion and a blackout taillamp in the lower portion. The stop lamp operates through the stop light switch, while the taillamps are controlled by the light switch (G, fig. 6).

(6) *Blackout marker lights* (fig. 85). The blackout marker lights are mounted in either side of the radiator grille below the headlights. These lights are controlled by the light switch and show a diffused, low intensity beam when on.

(7) *Trailer electric receptacle* (fig. 10). This is a four terminal receptacle, mounted at the left rear corner of the body. This receptacle provides a means of connecting the electrical units of a towed trailer to the electrical system of the vehicle. Trailer lights are controlled by the vehicle light switch (G, fig. 6).

b. Battery Data.

Manufacturer	Auto-Lite
Model	2 HN
Voltage	12
Plates per cell	11
Number of batteries used	2

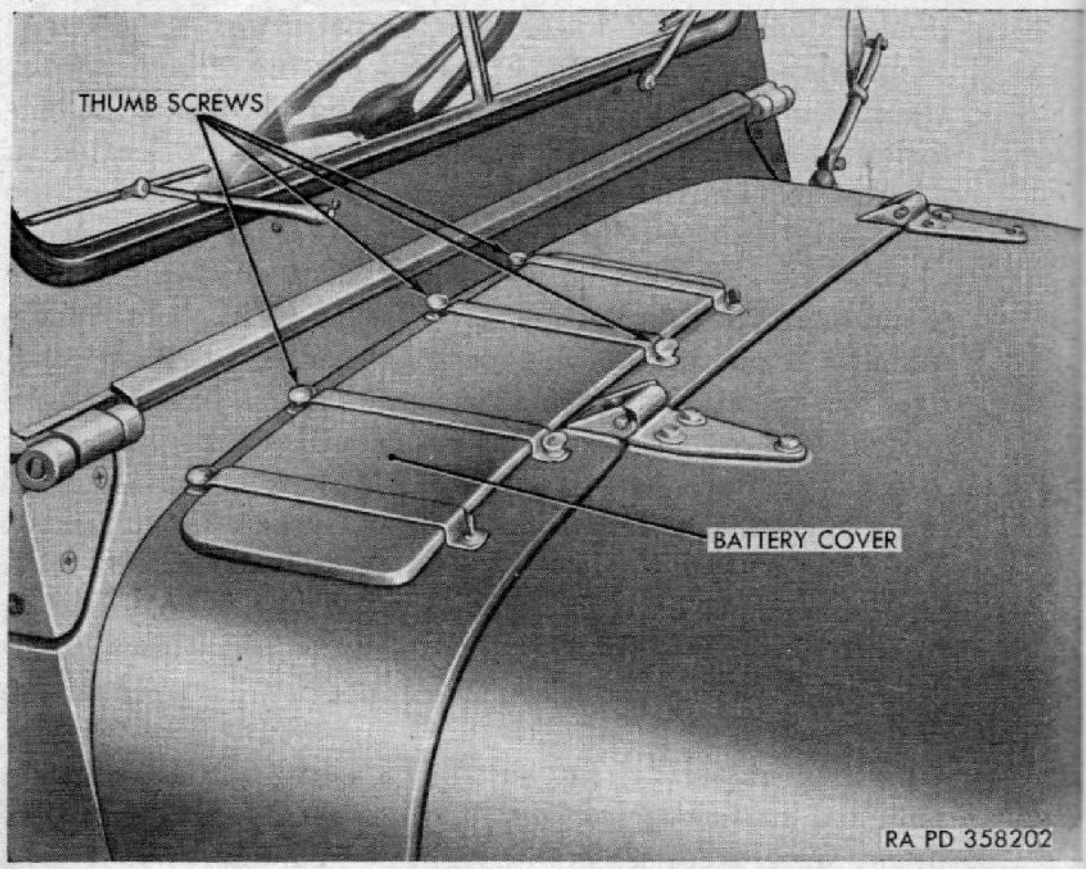


Figure 77. Batteries location.

127. Batteries

a. Cleaning. Battery terminals, batteries, and battery compartment must be kept clean. Clean tops of batteries, battery hold-downs, and battery compartment with a brush dipped in an alkaline solution such as ammonia or a solution of bicarbonate of soda and water. After foaming stops. flush off with clean water. If terminals and terminal bolts are corroded, disconnect battery cables, remove terminals, and clean in manner outlined above. After installing terminals and connecting battery cables, waterproof terminals and cable connections with packing and waterproof materials.

b. Testing.

(1) *Specify gravity test.*

(*a*) Specify gravity testing of the battery electrolyte (battery fluid) determines the state of charge in each battery cell. Use an accurate hydrometer and correct hydrometer reading for temperatures in accordance with table IV. A corrected specific gravity reading of 1.285 in each cell indicates a fully charged battery. A specific gravity reading of 1.225 or less in each cell indicates that the battery must be recharged or replaced.

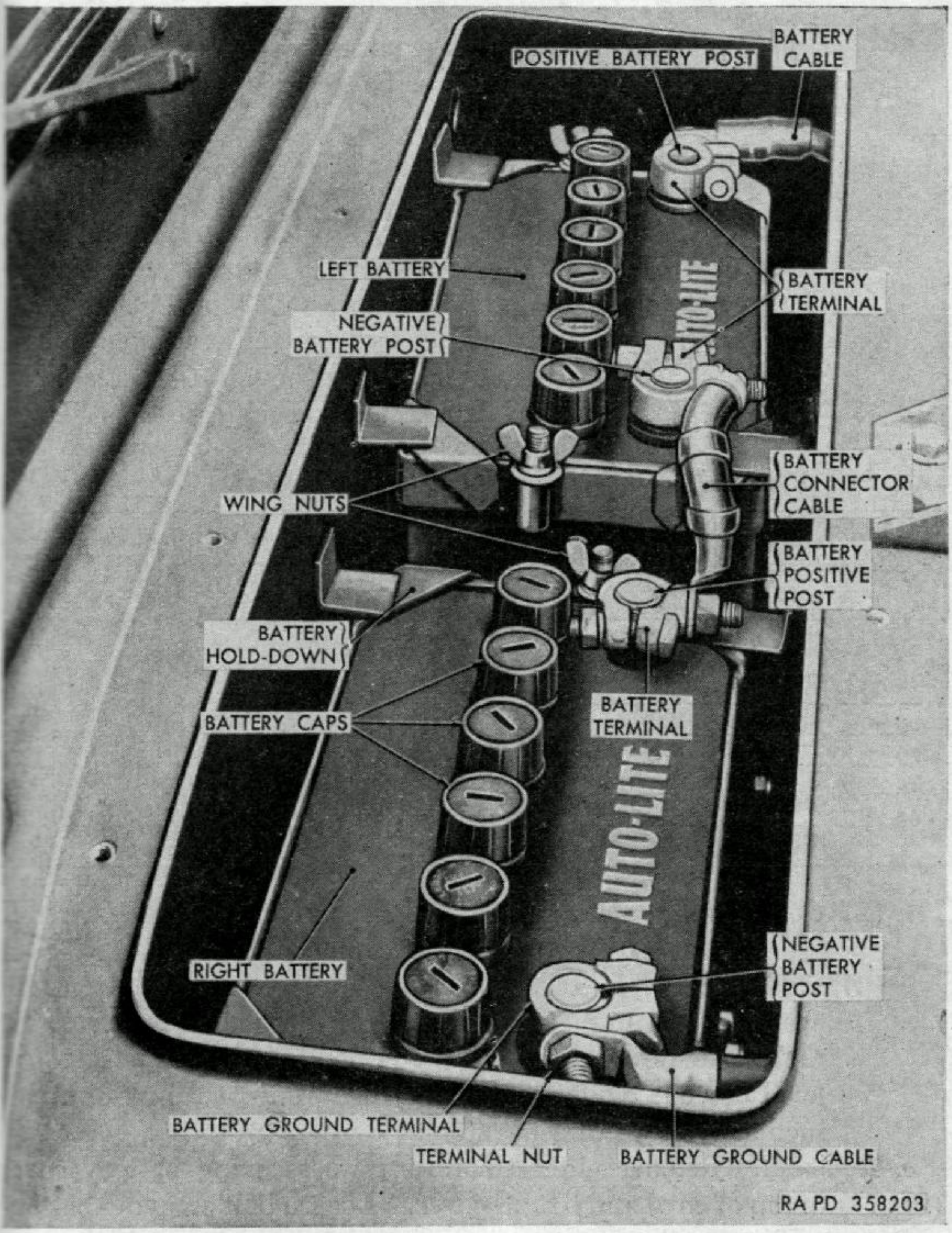


Figure 78. Batteries installed with battery cover removed.

(*b*) Battery hydrometer floats are calibrated to indicate at only one fixed temperature (80° F.). At low temperatures, it is important to correct hydrometer readings. When acid is cooled, it shrinks in volume, becomes more dense, and causes the hydrometer float to rise higher, giving a reading that is too high. For example, a hydrometer reading of 1.280 at electrolyte temperature of 20° F. is actually 1.240. Unless hydrometer is equipped with a thermometer and correction chart, corrected readings at low temperatures may be computed as follows: subtract four points (0.004) of specific gravity reading for each 10° F. change of electrolyte temperature between 80° F. and the actual temperature of the electrolyte. For example: If the specific gravity reading is 1.312 at 0° F., subtract four points (0.004) for each 10° F. between 80° and 0° F. (80 over 10) or 0.004×8, which is 32 points (0.032). Corrected reading will be 1.312 minus 0.032, or 1.280. Table IV shows how marked the hydrometer readings change with relation to temperatures although the calculated specific gravity reading is 1.280 in each case.

Table IV.—Temperature Correction Chart

Safe operating temperatures (degree F.)	Actual hydrometer specific gravity reading (fully charged battery)	Correction	Calculated specific gravity reading corrected to 80° F.
80	1. 280	0. 000	1. 280
0	1. 312	. 032	1. 280
−10	1. 316	. 036	1. 280
−20	1. 320	. 040	1. 280
−40	1. 328	. 048	1. 280
−65	1. 338	. 058	1. 280

(2) *Cell voltage.* Due to the sealed construction of submersible type batteries, cell voltage tests cannot be made.

(3) *Adding water.* The water in the electrolyte solution will evaporate at high temperature or with excessive charging rates. Remove battery caps (fig. 78) and inspect electrolyte level often. Add clean or distilled water to three-fourths-inch above tops of separators.

c. Removal. Remove eight thumb screws securing battery cover (fig. 77) to top of cowl and lift off cover. Loosen bolt securing battery ground terminals (fig. 78) to negative battery post of right battery and position battery ground cable so it cannot accidentally strike the battery post. Loosen bolts securing battery connector cable to positive post of right battery and negative post of left battery and lift battery connector cable, with battery terminals attached, off battery posts. Loosen bolt securing battery terminal to positive terminal of battery posts. Remove the two wing nuts, lock washers, and flat washers securing each battery hold-down in position and remove battery hold-downs. Lift batteries from battery compartment.

d. Installation. Clean batteries (fig. 78) thoroughly (*a* above) before installing. Install batteries in battery compartment, making sure the positive battery post is to the left side. Position battery hold-down over batteries and secure each battery hold-down with two flat washers, lock washers, and wing nuts. Install battery terminal with battery cable attached on positive post of left battery and tighten bolt securely. Place battery connector cable with battery terminals over negative post of left battery and positive post of right battery and tighten terminal bolts securely. Place battery ground terminal on negative battery post of right battery and tighten terminal bolt securely. Place battery cover over battery compartment and secure with eight thumb screws.

e. Battery Cable Replacement (fig. 78).

(1) *Removal.* Remove the battery terminal nut from the battery ground terminal and remove the battery ground cable from the battery ground terminal on the right battery. Remove terminal nut and flat washer securing opposite end of battery ground cable from the ground terminal (fig. 69) on the generator regulator base. Pull the battery ground cable through the opening in the side of the battery compartment. Remove the battery terminal nut securing the battery cable to the positive terminal of the left battery. Remove nut and flat washers securing battery cable to the starter switch terminal and remove battery cable. Pull battery cable through opening in battery compartment.

(2) *Installation.* Install battery cable through opening in battery compartment and connect to starter switch terminal (fig. 65) with terminal nut and flat washer. Connect other end of battery cable to battery terminal on positive battery post of left battery and secure with terminal nut. Install battery ground cable (fig. 69) through opening in battery compartment and connect one end to ground terminal on generator regulator base with flat washer and nut. Connect other end of battery ground cable to battery ground terminal on negative post of right battery and secure with terminal nut. Install battery cover (fig. 77) and secure with eight thumb screws.

128. Service Head Lights

a. Adjustment.

(1) Headlight beams must be accurately aimed. When aiming headlights, replace sealed beam lamp unit if pattern is distorted (*b* below). Beam distortion is usually due to a

sprung, distorted, or dented reflector, a condition sometimes caused by careless handling.

(2) Conventional aiming equipment should be used when aiming headlights; however, headlight beam can be accurately adjusted as follows:

(*a*) Position unloaded vehicle on level floor with headlights 25 feet from a smooth vertical surface such as a wall or a door, preferably of light color. Inflate tires to proper pressure (par. 211). Vehicle centerline (fig. 79) must be perpendicular to the vertical surface and centerline of vehicle must be in line with center line of chart.

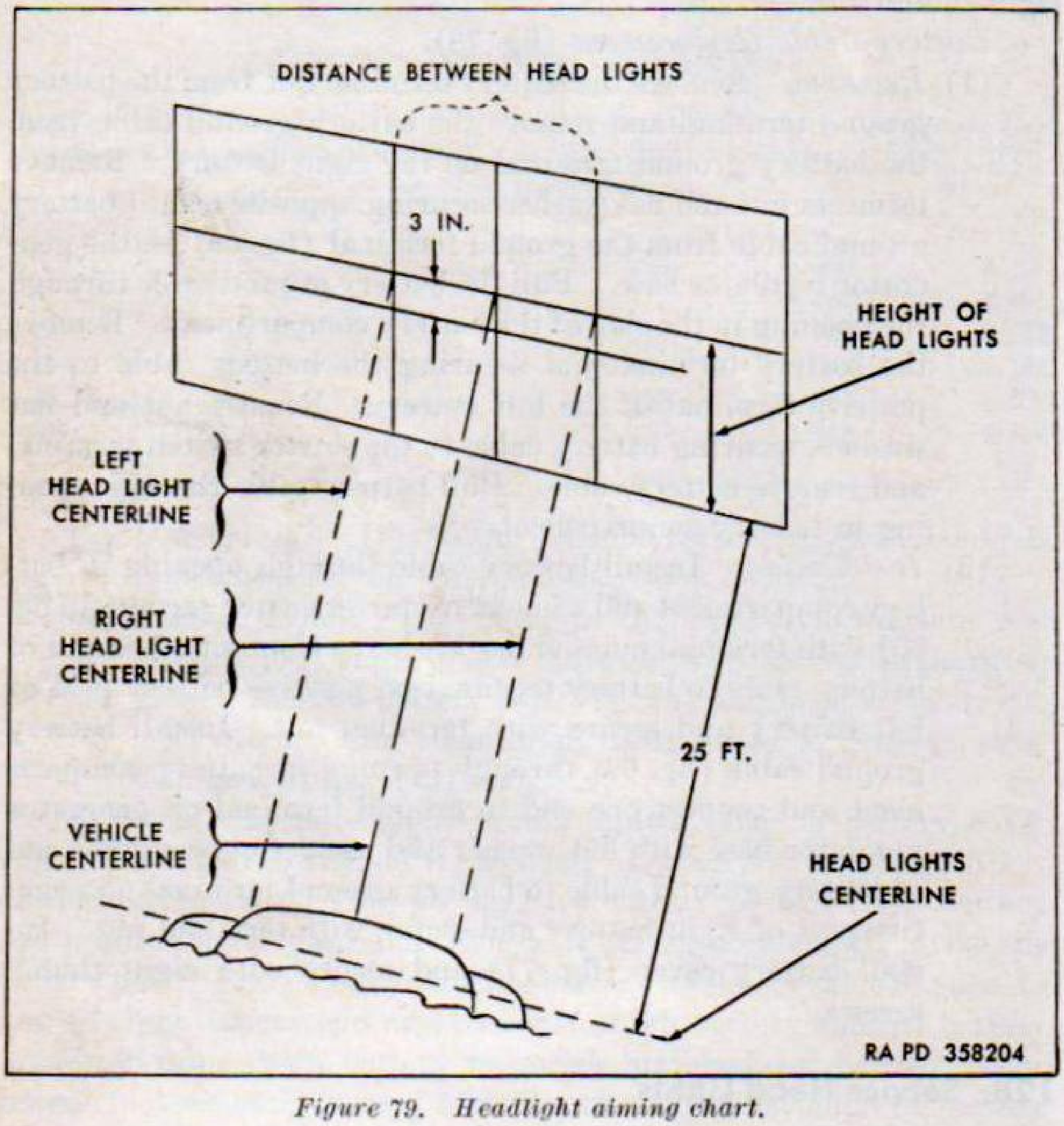


Figure 79. Headlight aiming chart.

(*b*) Measure height of headlight center from floor; then draw a horizontal line on vertical surface of aiming chart (fig. 79). Draw a second line parallel with and 3 inches below the first line.

(*c*) Locate a point at which projected centerline of vehicle intersects these two lines. Measure distance between two headlights centers; then divide this distance equally on both side of center line. Draw a vertical line through each of these points (fig. 79).

(*d*) Remove three screws securing headlight rim to headlight body and remove headlight rim. Turn on headlights (par. 41) and select light beam with dimmer switch.

(*e*) Cover one headlight while adjusting the other. Aim headlight beam with two horizontal adjustment screws (fig. 80). Top adjusting screw provides vertical adjustment and side screw provides horizontal adjustment. Turn adjusting screws as necessary to obtain beam pattern as near as possible to that shown in figure 81. Adjust opposite headlight in same manner.

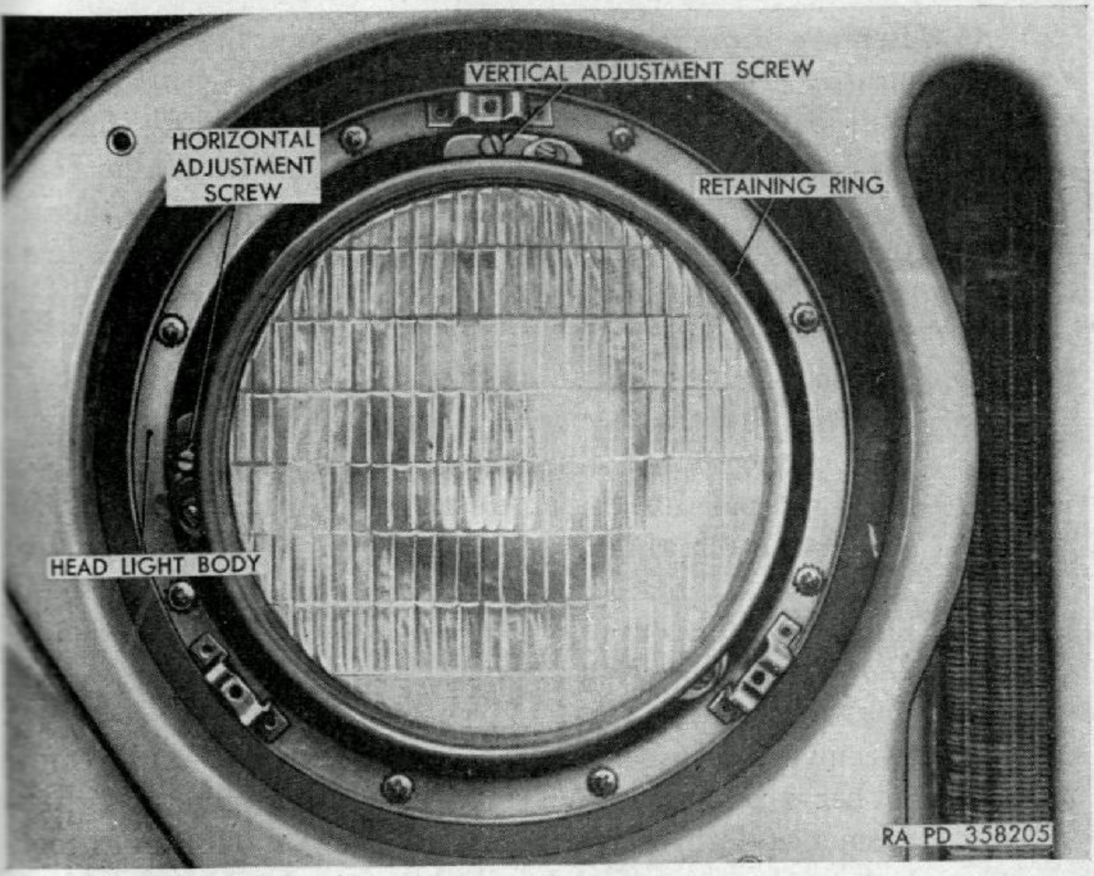


Figure 80. Service headlight adjusting screws.

(*f*) Install headlight rim and secure to headlight body with three screws.

b. Sealed-Beam Lamp Unit Replacement.

(1) *Removal.*

(*a*) Remove three screws securing headlight rim to headlight body and remove headlight rim.

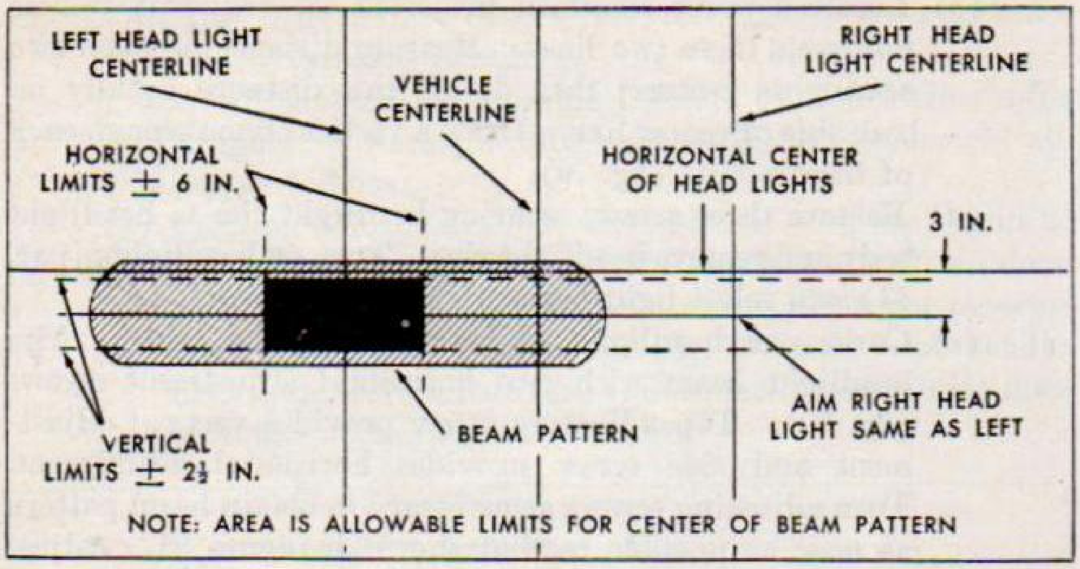


Figure 81. Headlight beam pattern.

(*b*) Remove three screws securing retaining ring (fig. 80) to headlight body and remove retaining ring.

(*c*) Pull sealed-beam lamps unit from headlight body (fig. 82). Disengage connectors from clips behind headlight body. Pull connectors (fig. 82) into open and disconnect headlight cables at connectors. Remove sealed-beam lamp unit.

(2) *Installation.*

(*a*) Connect connectors on headlight cables in headlight body (fig. 82) to connector on new sealed-beam lamp unit. Engage connectors in clips behind headlight body.

(*b*) Position sealed-beam lamp unit in headlight body and install retaining ring (fig. 80) securing with three screws. Adjust headlight beam pattern (*a* above). Install headlight rim and secure with three screws.

c. Head Light Assembly Replacement.

(1) *Removal.*

(*a*) Remove sealed-beam lamp unit (*b* above) and remove rubber grommet (fig. 83) and headlight cables (fig. 83) from headlight body. Remove screw and internal-tooth lock washers securing headlight ground cable (fig. 83) to grille.

(*b*) Remove eight screws and internal-tooth lock washers securing headlight body (fig. 80) to grille and remove headlight body.

(2) *Installation.*

(*a*) Position headlight body in grille and secure with eight screws and internal-tooth lock washers.

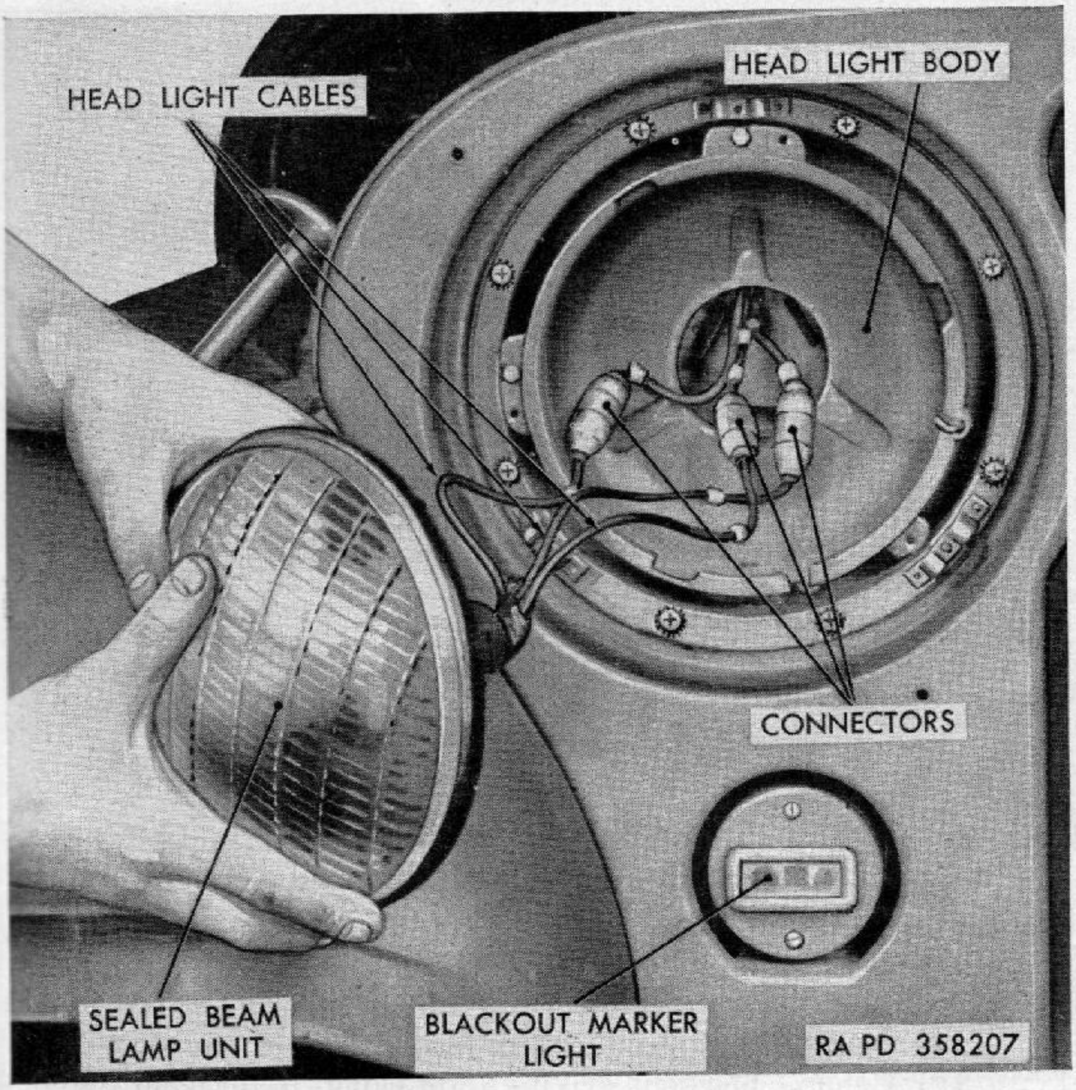


Figure 82. Removing sealed-beam lamp unit.

(*b*) Install rubber grommet with headlight cables (fig. 83) in headlight body. Connect headlight ground cable (fig. 83) to grille with screw and internal-tooth lock washers. Install sealed-beam lamp unit (*b* above).

129. Blackout Driving Light

a. Sealed-Beam Lamp Unit Replacement.

(1) *Removal.*

(*a*) Loosen three screws securing blackout driving light door (fig. 84) to blackout driving light housing (fig. 84).

Note.—Screws in blackout driving light door (fig. 84) are retained in door by wire clips.

(*b*) Unclip connectors (fig. 84) from clips in blackout driving light housing and disconnect cables at connectors.

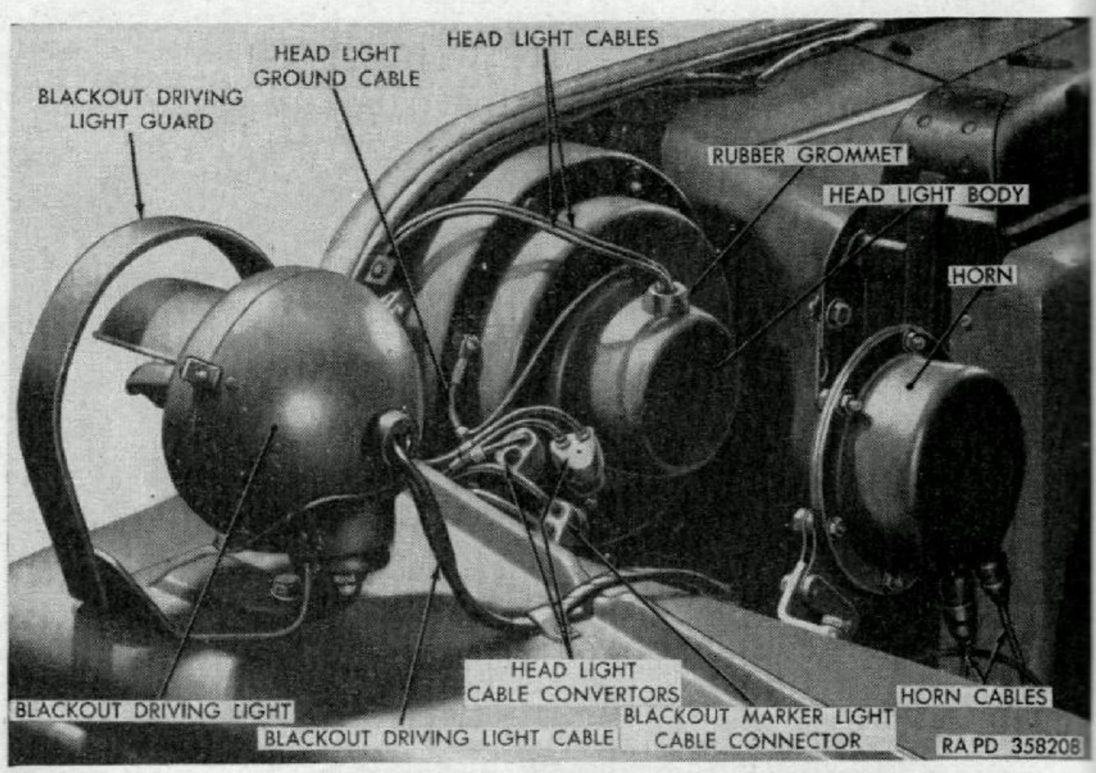


Figure 83. Headlight, blackout driving light, and horn installed.

(*c*) Remove three retaining clips (fig. 84) securing sealed-beam lamp unit to blackout driving light door and remove sealed-beam lamp unit.

(2) *Installation.*

(*a*) Position sealed-beam lamp unit in blackout driving light door and secure with three retaining clips (fig. 84).

(*b*) Connect blackout driving light cables in blackout driving light housing and cables on new sealed-beam lamp unit at connectors and install connectors in clips in blackout driving light housing (fig. 84).

(*c*) Position blackout driving light door with sealed-beam lamp unit on blackout driving light housing and secure with three screws.

b. Blackout Driving Light Assembly Replacement.

(1) *Removal.* Disconnect blackout driving light cable (fig. 83) at connector on left fender. Remove blackout driving light cable from clips attaching it to fender. Remove three cap screws and lock washers attaching blackout driving light guard to left fender and remove blackout driving light with guard attached.

(2) *Installation.* Position blackout driving light with guard attached on left fender and secure with three cap screws and lock washers. Attach blackout driving light cable to clips in left fender and to connector.

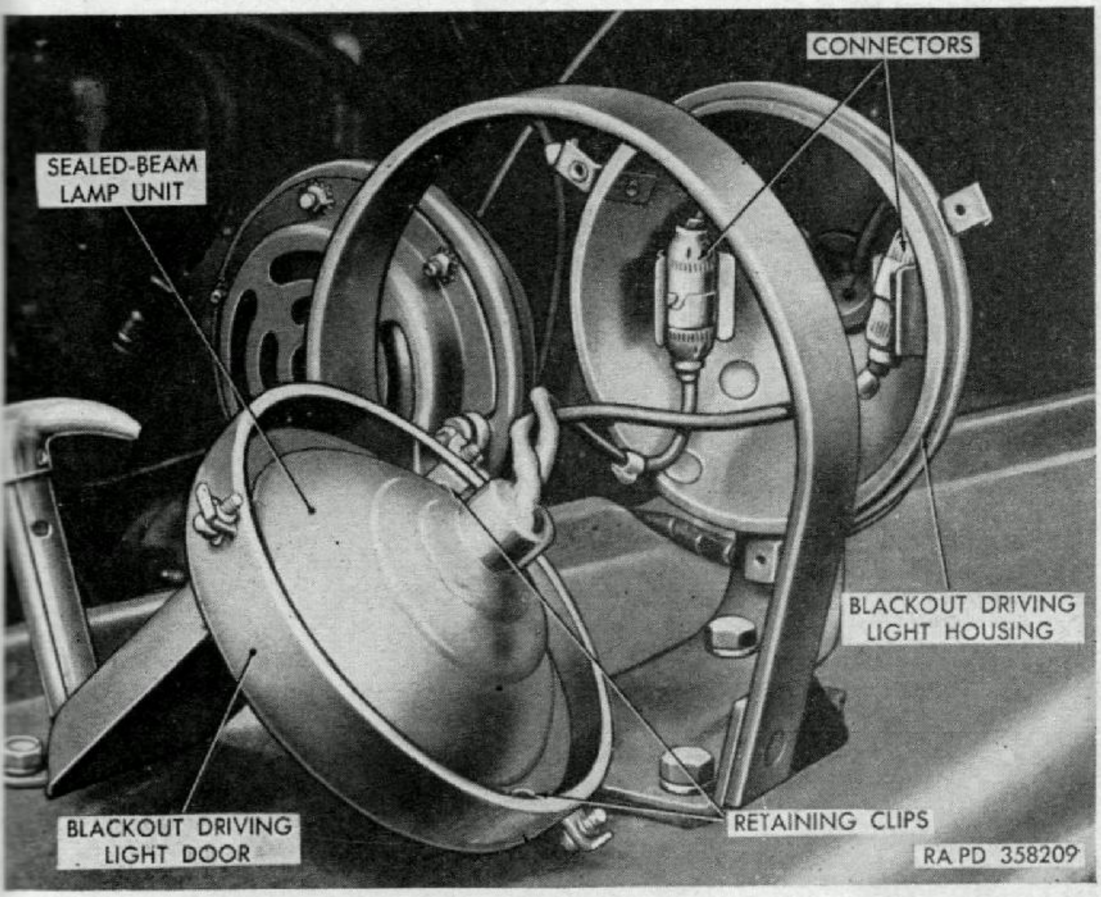


Figure 84. Blackout driving light with sealed-beam lamp unit removed.

130. Blackout Marker Lights

a. Lamp Replacement.

(1) *Removal.* Remove two screws securing blackout marker light door to blackout marker light (fig. 82). Remove blackout marker light door and waterproof gasket. Push in on lamp (fig. 85) and turn counterclockwise to remove lamp from socket.

(2) *Installation.* Insert lamp (fig. 85) into socket and turn clockwise to secure. Install waterproof gasket and door of blackout marker light (fig. 82) and secure with two screws.

b. Blackout Marker Light Assembly Replacement.

(1) *Removal.* Disconnect blackout marker light cable from bayonet type connector near blackout marker light, inside the engine compartment. Remove the nut, lock washer, and rubber grommet securing blackout marker light or grille.

(2) *Installation.* Position blackout marker light in grille and secure with rubber grommet, lock washer, and nut. Connect blackout marker light cable to connector.

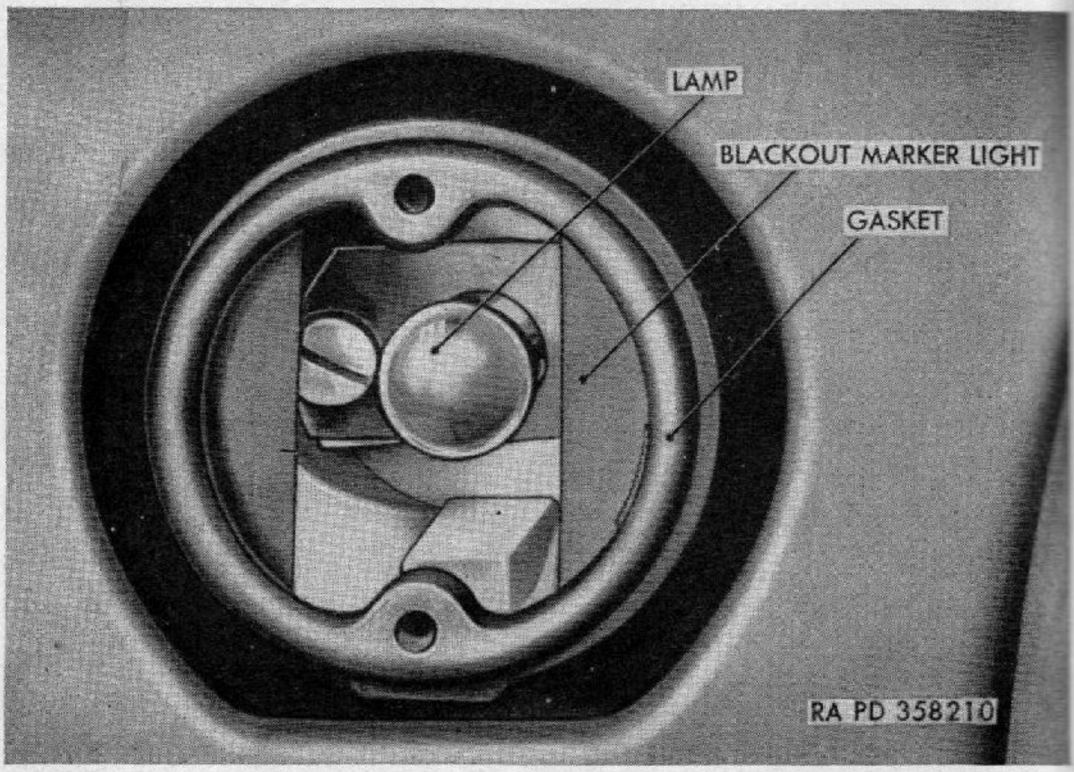


Figure 85. Blackout marker light with blackout marker light door removed.

131. Stop and Taillights

a. Stop and Taillamp Replacement.

(1) *Removal.* Remove six screws securing taillight door (fig. 86) to taillight body and remove taillight door and rubber gasket (fig. 86). Remove any of the three lamps (two lamps in right taillight), which are defective, by pushing in on lamp and turning counterclockwise.

(2) *Installation.* Insert the replacement lamp in the socket and turn clockwise to secure. Install rubber gasket and taillight door (fig. 86) on taillight body and secure with six screws.

b. Stop and Taillight Assembly Replacement.

(1) *Removal.* Disconnect stop and taillight cables at connectors inside body and remove stop and taillight cables from clips and body. Remove two cap screws and lock washers securing stop and taillight to bracket and remove stop and taillight from recess in body.

(2) *Installation.* Position stop and taillight in recess in body and secure to bracket with two cap screws and lock washers. Connect stop and taillight cables at connectors inside body and insert stop and taillight cables in clips on body.

132. Electric Trailer Receptacle

a. Removal. From inside body, disconnect cable connector at rear of trailer electric receptacle (fig. 10). Remove four screws securing

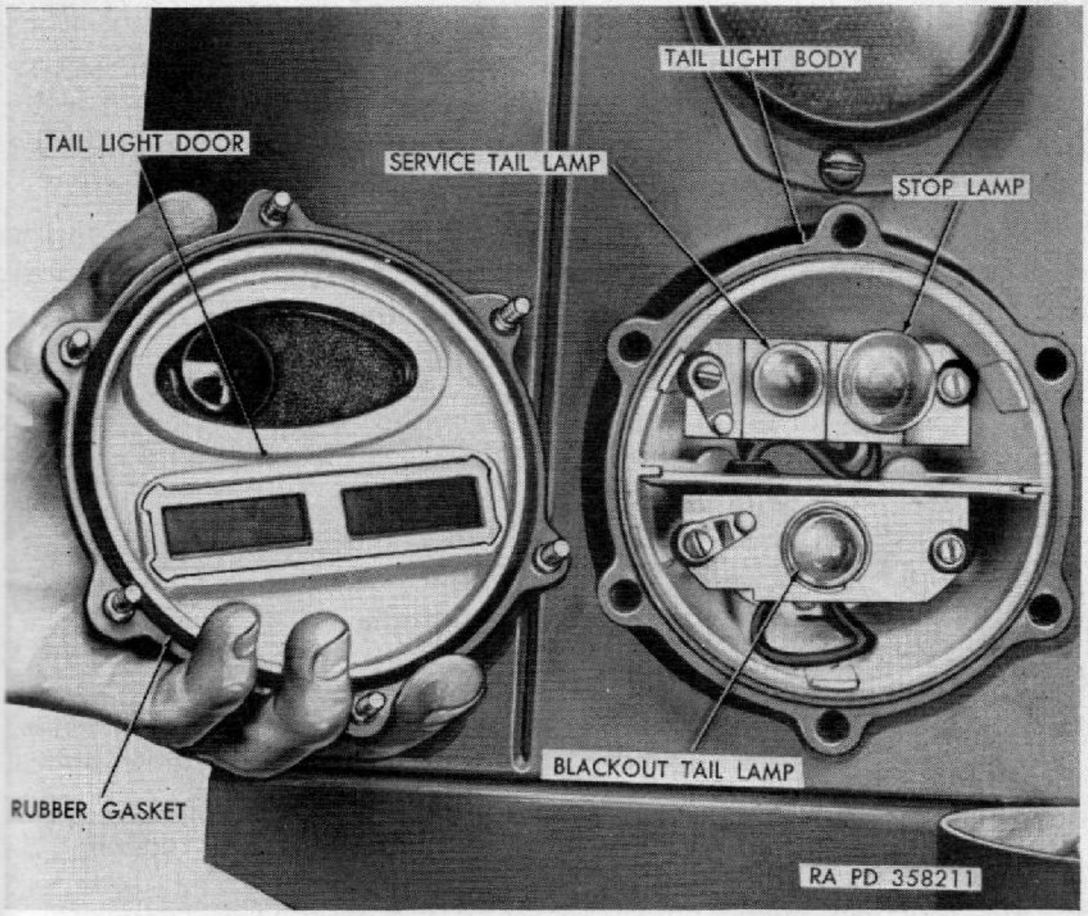


Figure 86. Stop and taillight with taillight door removed.

electric trailer receptacle to outside of body and remove electric receptacle from vehicle.

b. Installation. Install electric trailer receptacle on vehicle and secure with four screws. Connect cable connector to receptacle at rear of electric trailer receptacle.

133. Horn

a. Removal. Disconnect horn cables (fig. 83) at connectors on horn. Remove two cap screws and lock washers attaching horn and horn bracket to inside of left fender and remove horn with bracket attached.

b. Installation. Install horn with bracket attached on inside of left front fender and secure with two cap screws and lock washers. Connect horn cables (fig. 83) at connectors on horn.

134. Wiring Circuits and Cables

a. General. Each electrical cable, with the exception of spark plug cables, is identified by a numbered metal tag at each end of the cable. All cables in a single circuit are identified by the same number; however, when cables are connected through more than one connector, they may connect to a different numbered terminal at each connector. Reference should be made to the vehicle wiring diagram (fig. 87) when making cable replacement or connections. Grouped connections are made through multiple pin type connectors. Single cable connections are made through bayonet type connectors held together by interlocking sleeves. Rubber grommets inside the sleeves protect connections from moisture.

b. Circuit Identification. Table V lists each circuit number in the electrical system and briefly traces each circuit from its source to its end. A point-to-point check for circuit continuity can be made, using a conventional 24-volt test light or voltmeter equipped with long cables and suitable prods.

Table V.—Circuit Numbers and Descriptions

Circuit No.	Circuit description
4	Voltage regulator output A terminal to starter.
7	Battery to ground.
8	Voltage regulator output B terminal to positive ammeter terminal.
9	Voltage regulator output D terminal to negative ammeter terminal.
10	Voltage regulator output C terminal to horn switch, ignition switch, and light switch connector.
11	Ignition switch to light switch F terminal.
12	Distributor and ignition coil to ignition switch.
15	Generator regulator C terminal to light switch F terminal.
16	Light switch M terminal to dimmer switch.
17	Head light to dimmer switch and high beam indicator.
18	Head light to dimmer switch.
19	Light switch D terminal to blackout driving light.
20	Light switch E terminal to blackout marker lights.
21	Light switch H terminal to electric trailer receptable E terminal and left tail light.
22	Light switch C terminal to electric trailer receptacle B terminal and left tail light.
23	Light switch N terminal to electric trailer receptacle F terminal and right tail light.
24	Liht switch E terminal to electric trailer receptacle H and C terminals and right and left taillights.
25	Horn circuit from voltage regulator C terminal to horn switch, horn, and horn ground.
27	Instrument panel to ignition switch.
28	Fuel gage to fuel gage sending unit.
33	Engine temperature gage to engine temperature gage sending unit.
36	Oil pressure gage to oil pressure gage sending unit.
40	Light switch B terminal to instrument panel lights.
41	Right battery positive terminal to left battery negative terminal.
75	Light switch A and K terminal to stop light switch.
82	Battery to starter.
85	Ignition switch to open connector.
90	Electric trailer receptacle to ground.
91	Blackout driving light and headlights to ground.

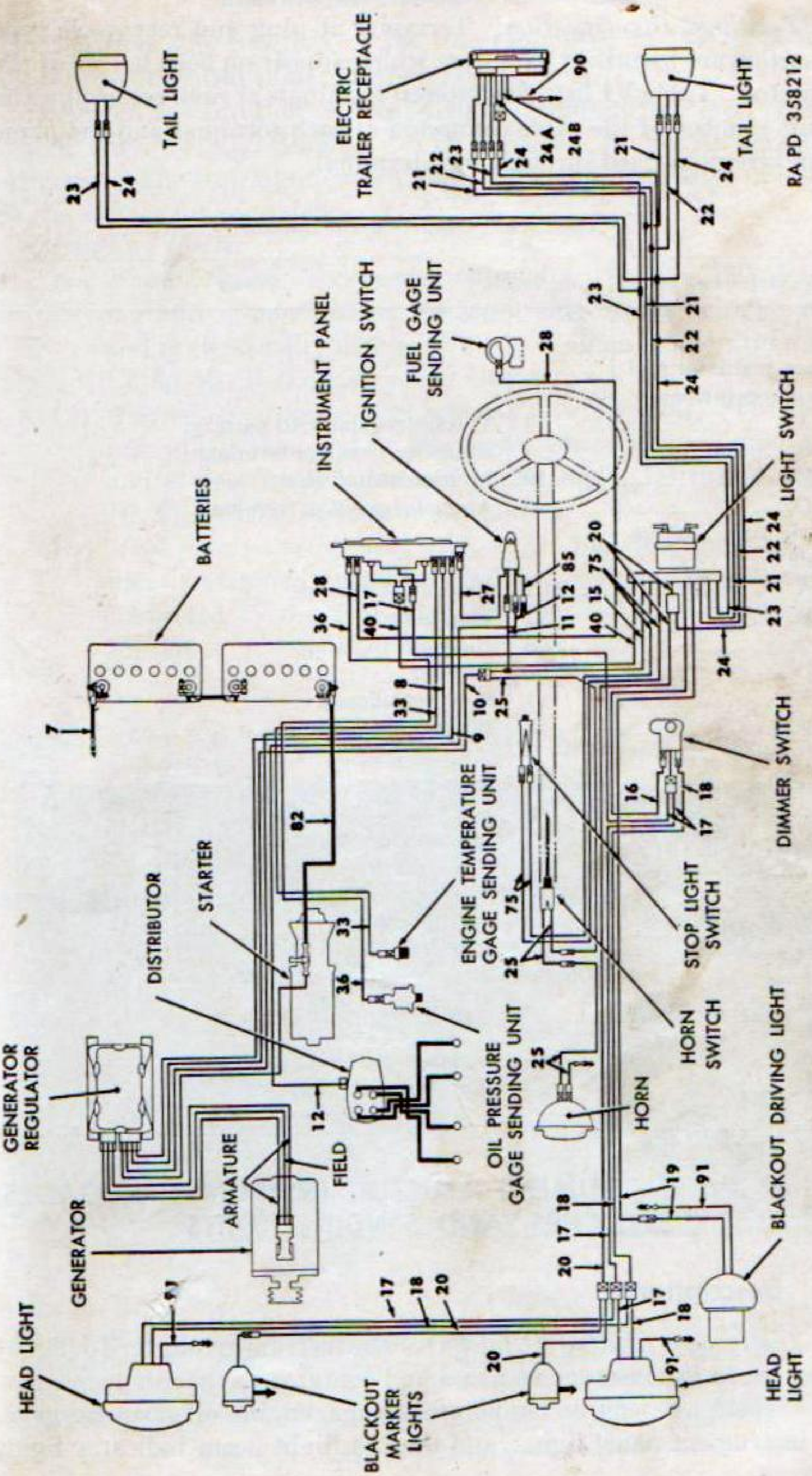


Figure 87. Vehicle wiring diagram and circuit identification.

c. Terminal Identification. Terminal at plug and receptacle type connectors are identified by letters which appear on both halves of the connector. Table VI lists the lettered terminals at each connector, the circuit number of the cable connected at each terminal and the name of the circuit carried through each terminal.

Table VI.—Connector Tabulation

Plug and receptacle letter	Cable No.	Circuit
Voltage regulator and plug. receptacle:		
A	4	Voltage regulator to battery.
B	8	Ammeter negative terminal.
C	10	Ignition switch feed.
D	9	Ammeter positive terminal.
Electric trailer receptacle:		
A	24A	Blackout taillamp.
B	22	Stop lamp.
C	24B	Blackout taillamp.
D	90	Ground.
E	21	Service taillamp.
F	23	Blackout stop lamp.
Light switch:		
A	75	Stop light switch.
B	40	Instrument panel lights.
C	22	Service stop lamp.
D	19	Blackout driving light.
E	20, 24	Blackout marker lights and blackout taillamps.
F	15	Ignition switch.
H	21	Service taillamp.
J	Open	
K	75	Stop light switch.
L	Open	
M	16	Dimmer switch.
N	23	Blackout stop lamp.

Section XV. INSTRUMENT CLUSTER, INSTRUMENTS, GAGES, SWITCHES, AND SENDING UNITS

135. Description

a. Instrument Cluster (C, fig. 88). The instrument cluster (J, fig. 6) is located in the instrument panel and contains the speedometer, ammeter, fuel gage, engine temperature gage, engine oil pressure gage, two instrument panel lights, and the headlight beam indicator light.

The location and function of the units mounted in the instrument cluster are described in paragraphs 11–38.

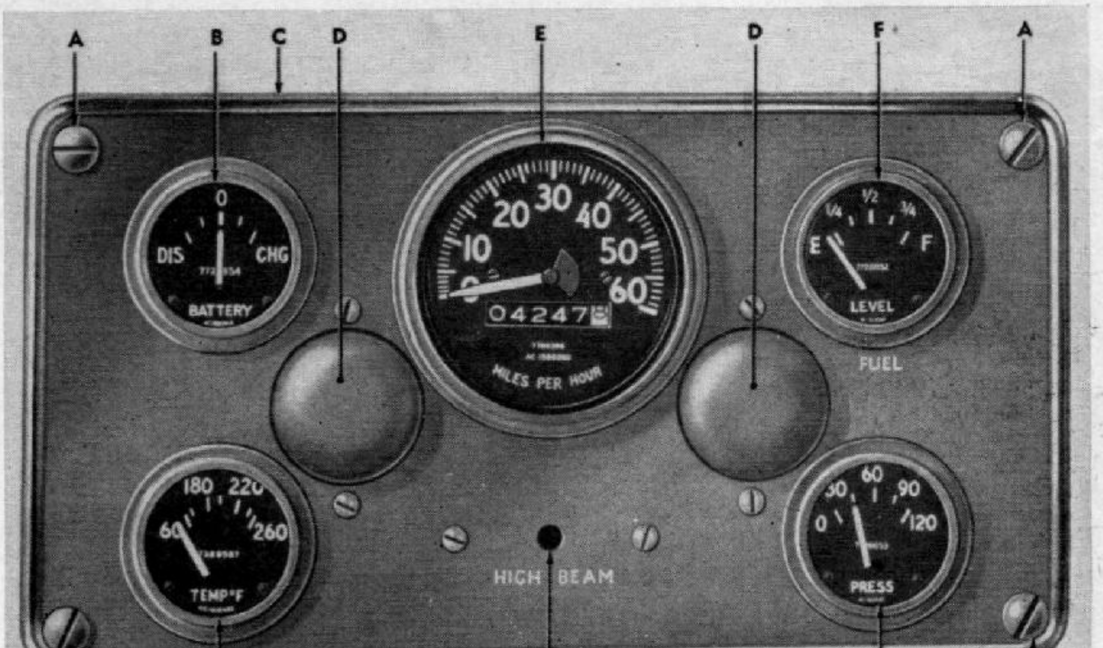
b. Switches. Ignition switch (Z, fig. 6), light switch (fig. 6), horn switch (fig. 87), and dimmer switch (FF, fig. 6) are all manually operated. The stop light switch (fig. 87) is automatically controlled by the service brake system.

c. Sending Units.

(1) *Engine temperature gage sending unit* (fig. 93). This sending unit is mounted on the right side of the cylinder head and is electrically connected to the engine temperature gage (J, fig. 88) in the instrument cluster.

(2) *Engine oil pressure gage sending unit* (fig. 93). This sending unit is mounted on the right side of the cylinder head and is electrically connected to the engine oil pressure gage (C, fig. 88) in the instrument cluster.

(3) *Fuel gage sending unit* (fig. 53). The fuel gage sending unit is mounted on top of the fuel tank and is electrically connected to the fuel gage (F, fig. 88) in the instrument cluster.



A—PANEL LOCK SCREWS
B—AMMETER
C—INSTRUMENT CLUSTER
D—INSTRUMENT PANEL LIGHTS
E—SPEEDOMETER
F—FUEL GAGE
G—ENGINE OIL PRESSURE GAGE
H—HEAD LIGHT BEAM INDICATOR LIGHT
J—ENGINE TEMPERATURE GAGE

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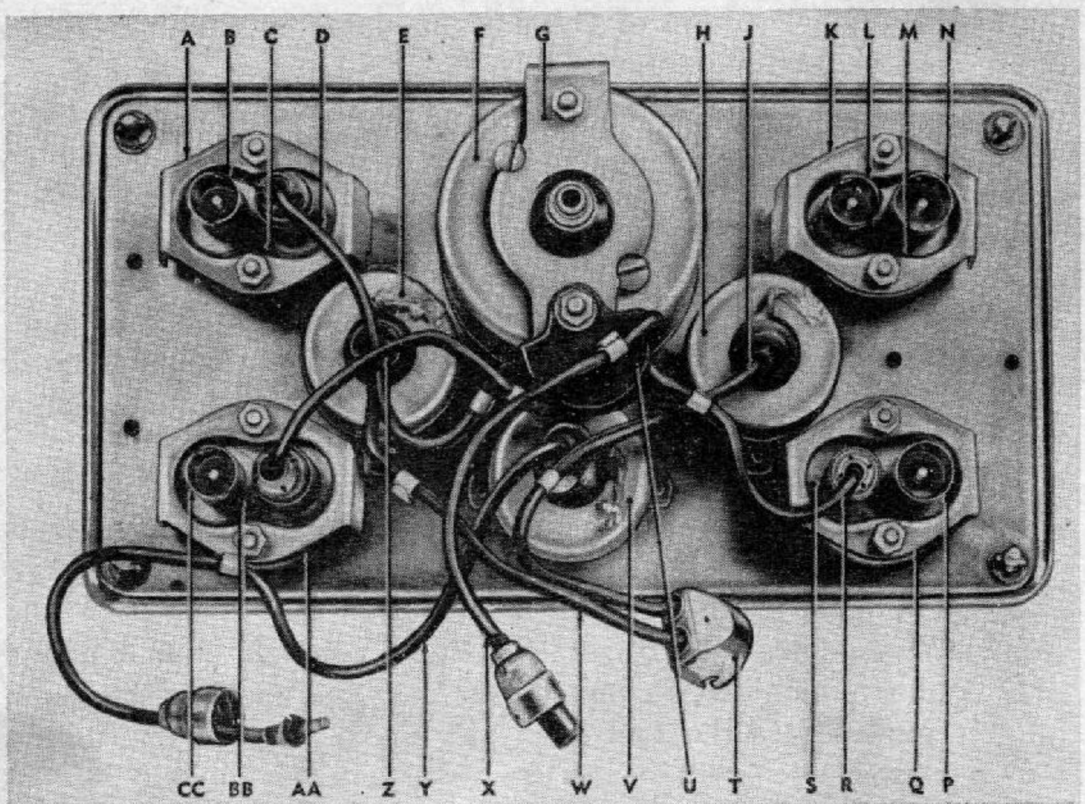
Figure 88. Instrument cluster—front view.



A—FUEL GAGE BRACKET
B—CABLE NO 28 TERMINAL
C—FUEL GAGE
D—CABLE NO 27
E—INSTRUMENT PANEL LIGHT
F—SPEEDOMETER
G—SPEEDOMETER BRACKET
H—INSTRUMENT PANEL LIGHT
J—CABLE NO 40
K—AMMETER BRACKET
L—CABLE NO 8 TERMINAL
M—AMMETER
N—CABLE NO 9 TERMINAL
P—CABLE NO 33 TERMINAL
Q—ENGINE TEMPERATURE GAGE BRACKET
R—CABLE NO 27
S—ENGINE TEMPERATURE GAGE
T—CONNECTOR
U—MOLDED SPLICE
V—HEAD LIGHT BEAM INDICATOR LIGHT
W—CABLE NO 40
X—CABLE NO 27
Y—CABLE NO 17
Z—CABLE NO 27
AA—ENGINE OIL PRESSURE GAGE BRACKET
BB—ENGINE OIL PRESSURE GAGE
CC—CABLE NO 36 TERMINAL

RA PD 358214

Figure 89. Instrument cluster—rear view.

136. Instrument Cluster

a. Removal. Instrument cluster is held in position on the instrument panel by four panel lock screws (A, fig. 88) located in each corner of the instrument cluster. Release these panel lock screws by turning counterclockwise one-half turn and pull instrument cluster out of instrument panel. Replacement of individual units in instrument cluster can be made with the instrument cluster in this position. To remove the complete instrument cluster assembly, disconnect all cables from units at connectors.

b. Installation. If instrument cluster assembly was completely removed, position instrument cluster at instrument panel and connect

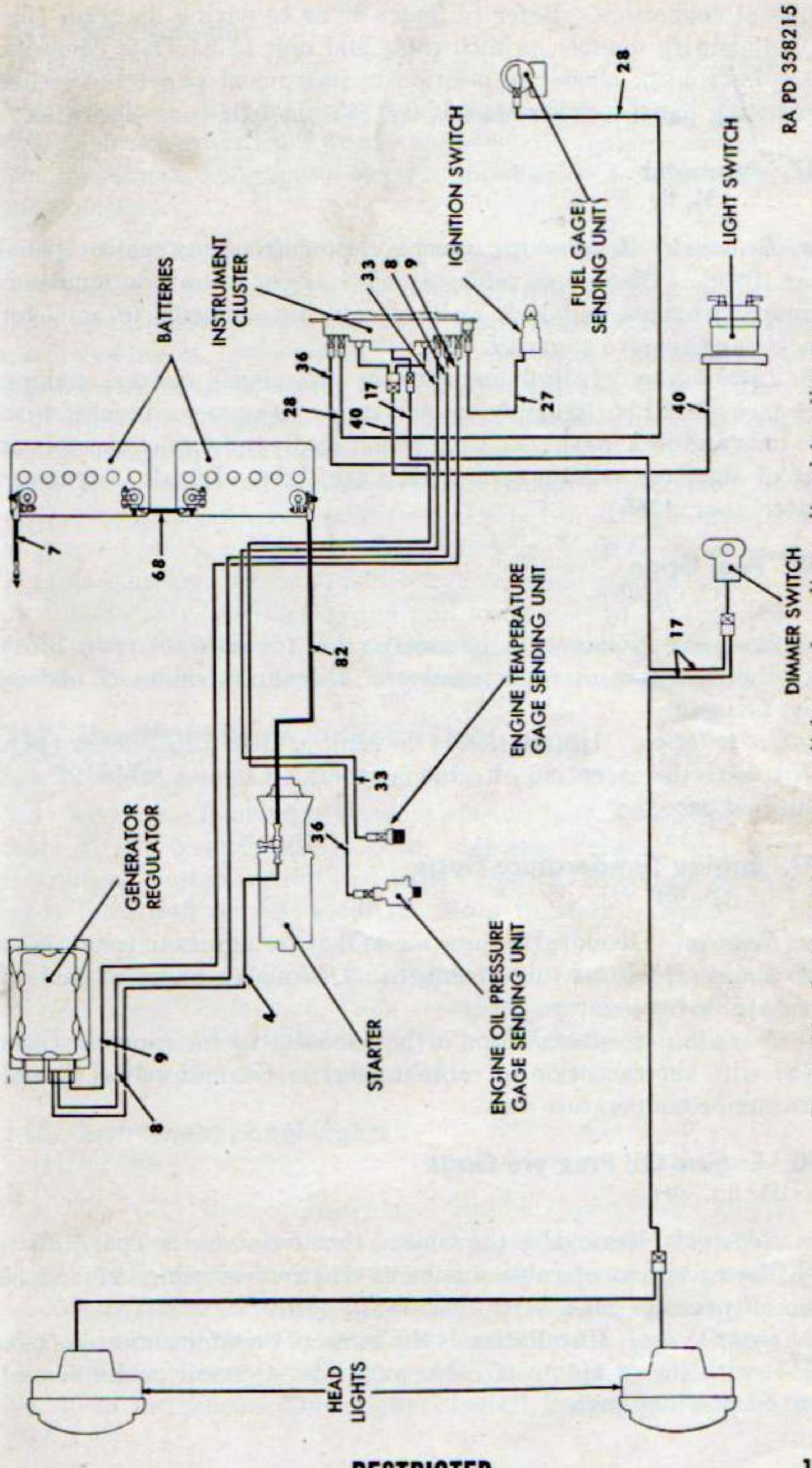


Figure 90. Instruments, gages, switches, and sending units wiring diagram.

cables at connectors. Refer to figure 89 or to wiring diagram (fig. 90) to identify number on each cable and unit to which it connects. Place instrument cluster in position in instrument panel and secure by turning panel lock screws (A, fig. 88) one-half turn clockwise.

137. Ammeter

(M, fig. 89)

a. Removal. Remove instrument cluster from instrument panel (par. 136*a*). Disconnect cables 8 and 9 at connectors on ammeter. Remove two nuts and lock washers securing ammeter to ammeter bracket and remove ammeter.

b. Installation. Install ammeter in instrument cluster, making sure face of dial is right side up, and secure to ammeter bracket with two nuts and lock washers. Connect cables 8 and 9 to connectors at rear of ammeter making certain they are tight. Install instrument cluster (par. 136*b*).

138. Fuel Gage

(C, fig. 89)

a. Removal. Removal is the same as that for ammeter (par. 137*a*) with the exception of cable members. Disconnect cables 27 and 28 from fuel gage.

b. Installation. Installation is the same as that for ammeter (par. 137*b*), with the exception of cable members. Connect cables 27 and 28 to fuel gage.

139. Engine Temperature Gage

(S, fig. 89)

a. Removal. Removal is the same as that for ammeter (par. 137*a*) with the exception of cable numbers. Disconnect cables 27 and 33 from engine temperature gage.

b. Installation. Installation is the same as that for ammeter (par. 137*b*) with the exception of cable numbers. Connect cables 27 and 33 to engine temperature gage.

140. Engine Oil Pressure Gage

(BB, fig. 89)

a. Removal. Removal is the same as that for ammeter (par. 137*a*), with the exception of cable numbers. Disconnect cables 27 and 36 from oil pressure gage.

b. Installation. Installation is the same as that for ammeter (par. 137*b*), with the exception of cable numbers. Connect cables 27 and 36 to oil pressure gage.

141. Speedometer
(F, fig. 89)

a. Removal. Remove instrument cluster (par. 136*a*). Disconnect flexible speedometer cable from speedometer. Remove two nuts and lock washers securing speedometer to speedometer bracket and remove speedometer.

Note.—Lower speedometer stud also provides for securing the molded splice.

b. Installation. Position speedometer in instrument cluster with long mounting stud in lower hole in speedometer bracket. Install molded splice on lower mounting stud and secure molded splice and speedometer to speedometer bracket with nut and lock washer. Install upper nut and lock washer. Connect speedometer cable to speedometer and install instrument cluster (par. 136*b*).

c. Speedometer Cable Replacement. Remove instrument cluster (par. 136*a*). Disconnect speedometer cable from speedometer. Using long nosed pliers, pull the speedometer cable out of the cable housing. If cable is broken, it may be necessary to disconnect speedometer cable at transfer rear bearing cap and pull lower part of broken cable out from the end. Thread new speedometer cable into housing and connect to speedometer. Install instrument cluster (par. 136*b*).

142. Headlight Beam Indicator Light
(V, fig. 89)

a. Removal. Remove instrument cluster (par. 136*a*). Disconnect cable No. 17 from headlight beam indicator light. From front of instrument cluster remove two screws securing headlight beam indicator light and remove headlight beam indicator light from back of instrument cluster.

b. Installation. Position headlight beam indicator light on back of instrument cluster and, from front of instrument cluster, install two screws. Connect cable No. 17 to headlight beam indicator light. Install instrument cluster (par. 136*b*).

143. Instrument Panel Lights
(E, fig. 89)

a. Removal. Remove instrument cluster (par 136*a*). Disconnect cable No. 40 from instrument panel light and, from front of instrument cluster, remove two screws and remove instrument panel light.

b. Installation. Position instrument panel light on back of instrument cluster and, from front of instrument cluster, install two screws to secure instrument panel light to instrument cluster. Connect cable No. 40 to instrument panel light. Install instrument cluster (par. 136*b*).

c. Lamp Replacement. Remove instrument panel light (*a* above). Press light cover and light body together and turn light body counterclockwise and separate light body and light cover. Press in on lamp, turn counterclockwise, and remove lamp from socket in light body. Insert replacement lamp in socket, press in, and turn clockwise to engage lugs on lamp with slots in socket. Place light cover and light body together, engage lugs on light body with slots on light cover, and turn light body clockwise to secure. Install instrument panel light (*b* above).

144. Ignition Switch

a. Removal.

(1) Disconnect battery ground cable (fig. 78) from negative terminal of right battery.

(2) Disconnect cables 27, 11, 12, and 85 (fig. 87) from back of ignition switch. Remove screw from center of switch lever and remove switch lever.

(3) Remove nut and washer securing ignition switch to instrument panel and remove ignition switch from back of instrument panel.

b. Installation.

(1) From back of instrument panel, position ignition switch in instrument panel and secure with nut and washer.

(2) Install switch lever on ignition switch and secure with screw placed in center of switch lever. Connect cables 27, 11, 12, and 85 (fig. 87) to back of ignition switch.

(3) Connect battery ground cable (fig. 78) to negative terminal of right battery.

145. Light Switch

a. Testing. Test light switch by setting switch levers in all positions and checking lights. Refer to figure 9 and paragraph 41 for combinations of settings.

b. Removal. Remove four screws attaching light switch to front of instrument panel and pull light switch away from instrument panel far enough to permit disconnection of electrical connections and disconnect cable plug from receptacle (fig. 91), using wrench 41–W–3249–900 (fig. 70).

c. Installation. Connect cable plug to receptacle (fig. 91) on back of light switch and tighten with wrench 41–W–3249–900 (fig. 70). Position light switch on instrument panel and secure with four screws.

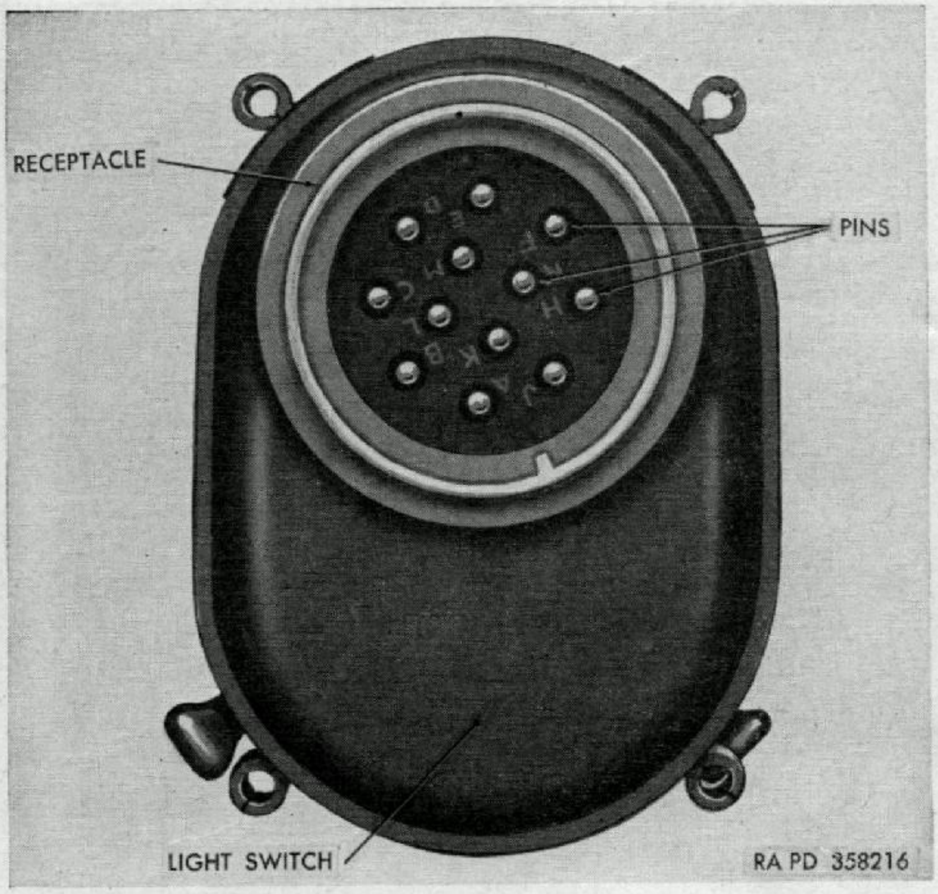


Figure 91. Light switch—rear view.

146. Dimmer Switch
(fig. 92)

a. Removal. Disconnect cables 16 and 18 at connectors on back of dimmer switch and cable 17 at double connector. From inside passenger compartment, remove two cap screws securing dimmer switch to floor pan and remove dimmer switch.

b. Installation. Have a helper position dimmer switch to engine compartment side of floor pan; from inside the passenger compartment install two cap screws to secure dimmer switch to floor pan. Connect cable 17 to double connector and cables 16 and 18 at connectors on back of dimmer switch.

147. Horn Switch

a. Removal. Disconnect two cables No. 25 from horn switch (fig. 87) and remove horn switch from bottom of steering gear.

b. Installation. Install replacement horn switch on bottom of steering gear and tighten securely. Connect two cables No. 25 at connectors.

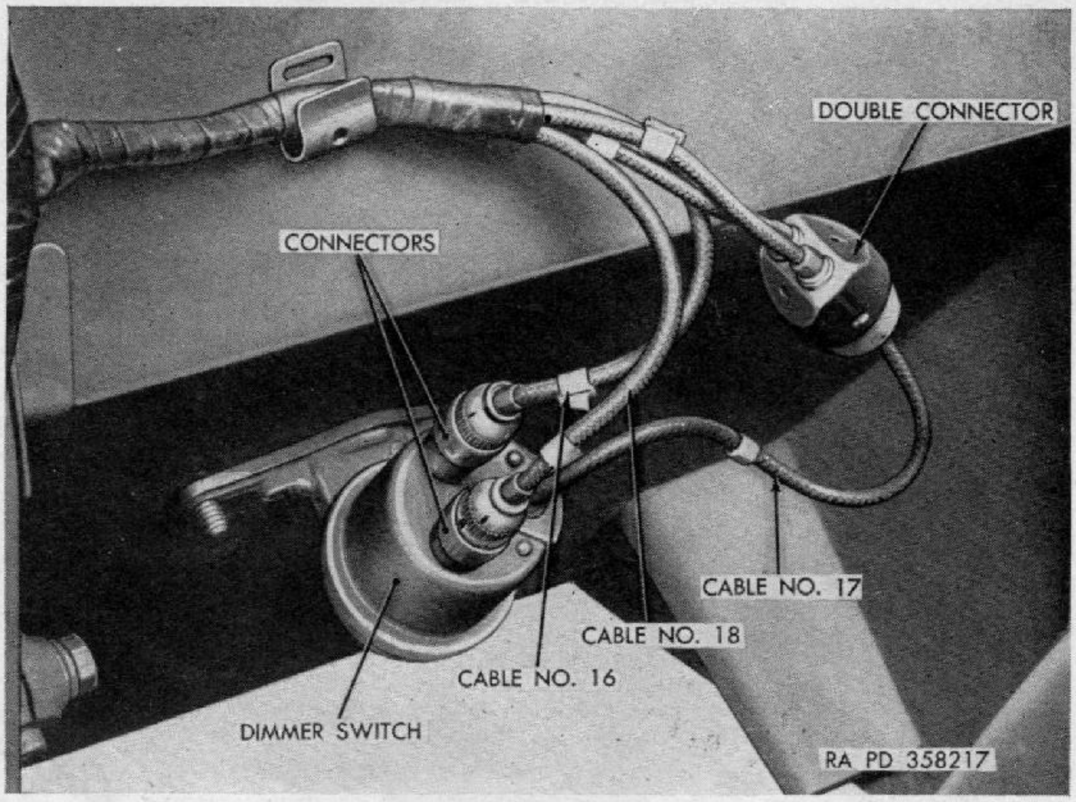


Figure 92. Dimmer switch installed.

148. Stop Light Switch

a. Removal. Disconnect cables No. 75 from two connectors on stop light switch and unscrew stop light switch from front of brake master cylinder.

b. Installation. Install replacement stop light switch on front of brake master cylinder and tighten securely. Connect cables No. 75 to connectors on stop light switch.

149. Engine Temperature Gage Sending Unit (fig. 93)

a. Removal. Disconnect cable No. 33 at connector on engine temperature gage sending unit; with a suitable wrench, remove the engine temperature gage sending unit from the cylinder head.

b. Installation. Install engine temperature gage sending unit in cylinder head and tighten securely. Connect cable No. 33 at connector on sending unit.

150. Engine Oil Pressure Gage Sending Unit (fig. 93)

a. Removal. Disconnect cable No. 36 at connector on engine oil pressure gage sending unit. Loosen screw on clamp around engine

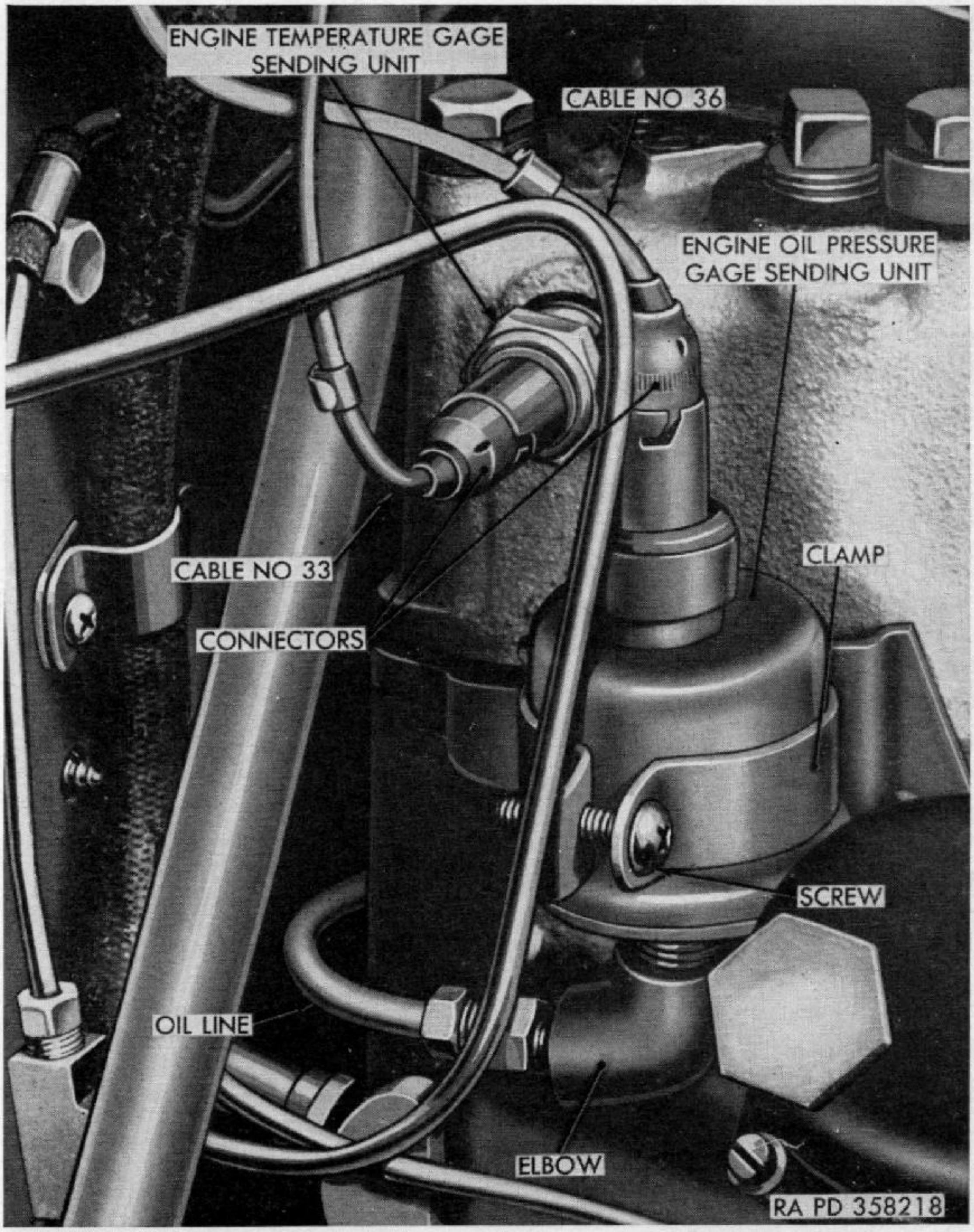


Figure 93. Engine temperature gage sending unit and engine oil pressure gage sending unit installed.

oil pressure sending unit and disconnect oil line from elbow. Remove engine oil pressure gage sending unit.

b. Installation. Place engine oil pressure gage sending unit in clamp and tighten screw. Connect oil line to elbow and connect cable No. 36 to connector on top of engine oil pressure gage sending unit.

151. Fuel Gage Sending Unit
(fig. 53)

a. Removal. Remove driver's seat (par. 214). Disconnect cable from fuel gage sending unit. Remove six screws with internal tooth lock washer and remove fuel gage sending unit from fuel tank. Remove rubber gasket.

b. Installation. Position rubber gasket over opening in fuel tank and place fuel gage sending unit over gasket, lining up holes in fuel gage sending unit and gasket. Install six screws with internal tooth lock washers and tighten securely. Connect cable to fuel gage sending unit. Install driver's seat (par. 214).

Section XVI. RADIO INTERFERENCE SUPPRESSION

152. Purpose

a. Radio interference suppression is the elimination or minimizing of the electrical disturbances which interfere with radio reception, or disclose the location of the vehicle to sensitive electrical detectors. It is important, therefore, that vehicles with, as well as vehicles without, radios be suppressed properly to prevent interference with radio reception of neighboring vehicles.

b. Suppression of these vehicles is accomplished by the use of metallic shielding, capacitors, and resistor suppressors. Wiring, that may carry interfering surges to a point where interference will effect radio reception, is shielded.

153. Description

a. Ignition System. Radio interference suppression in the ignition system (fig. 56) is accomplished by the use of resistors in the distributor rotor, distributor cover, and spark plugs and by shielding spark plug cables.

b. Generating System. The generating system circuit (fig. 67) is suppressed by a capacitor in the generator and by a capacitor, filter, and rectifier in the generator regulator.

Section XVII. CLUTCH

154. Description and Data

a. Description. The clutch is located between the engine and the transmission housed in the waterproof flywheel housing (fig. 43). The clutch is a single plate automotive type, composed of two major units, the pressure plate assembly and the driven plate or disk. The controlled pressure of the driven disk against the flywheel provides a means of engaging and disengaging the engine power with the transmission. The clutch is always in the engaged position unless disengaged by the operator by depressing the clutch pedal. The pressure plate assembly is adjusted at the factory and requires no other adjustments.

b. Data.

Manufacturer	Borg and Beck
Type	single dry plate
Size	$8\frac{1}{2}$ in

155. Clutch Adjustment

Due to the natural wear of lining on clutch plates, the clutch pedal adjustment must be periodically checked. The clutch pedal (fig. 94) must have at least $1\frac{1}{4}$ inch of free pedal travel before the clutch

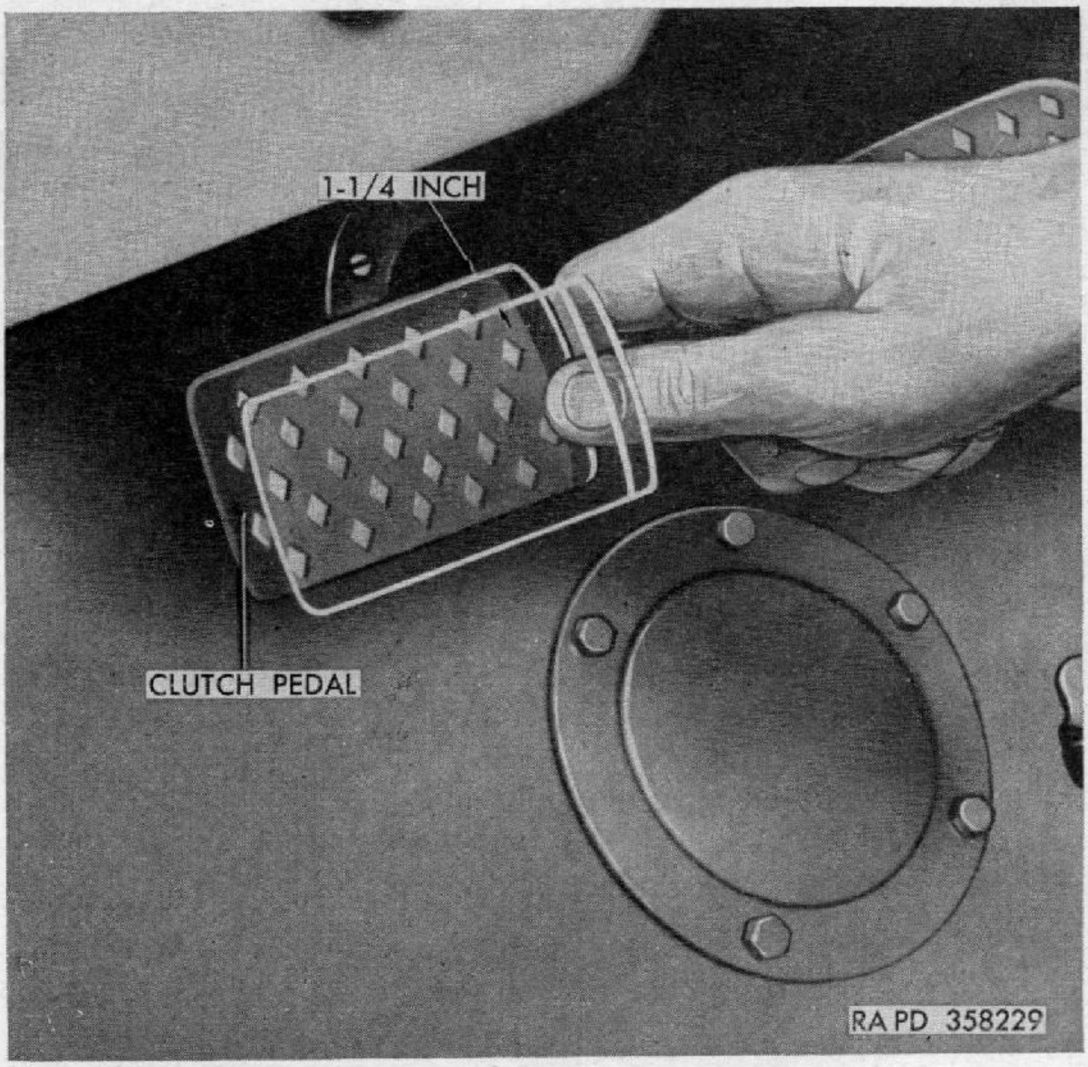


Figure 94. Clutch pedal free travel.

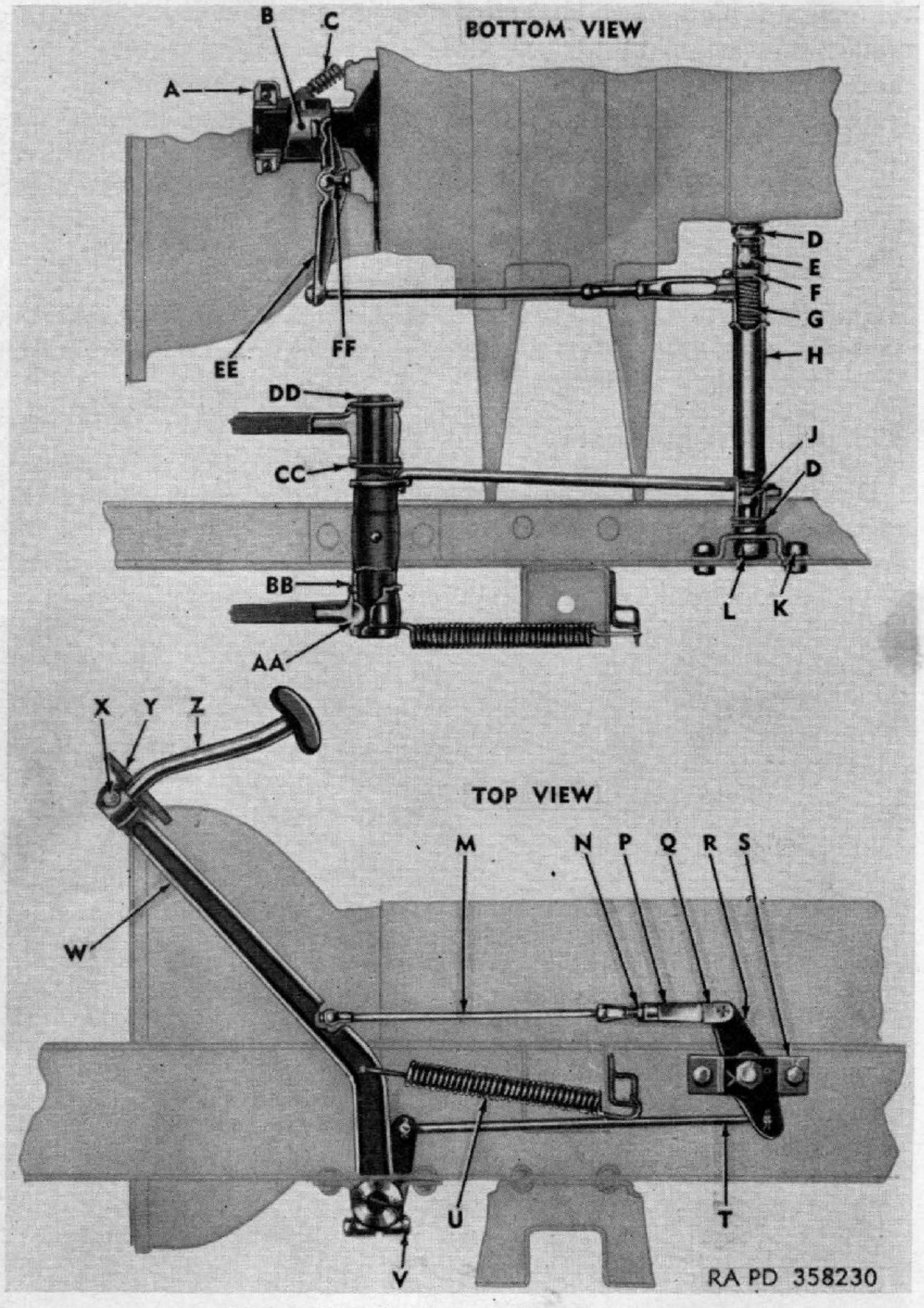


Figure 95. Clutch controls and linkage.

A—CLUTCH RELEASE BEARING
B—CLUTCH RELEASE BEARING CARRIER
C—CLUTCH RELEASE BEARING CARRIER SPRING
D—SEAL
E—BALL STUD
F—WASHER
G—SPRING
H—CONTROL TUBE AND LEVER
J—BALL STUD
K—FRAME BRACKET
L—NUT
M—CLUTCH CONTROL CABLE
N—CLUTCH CONTROL CABLE YOKE LOCK NUT
P—CLUTCH CONTROL CABLE YOKE
Q—CLEVIS PIN
R—LEVER
S—FRAME BRACKET NUT
T—PEDAL RELEASE ROD
U—CLUTCH PEDAL RETURN SPRING
V—CLUTCH PEDAL CLAMP BOLT
W—CLUTCH PEDAL
X—PEDAL PAD CLAMP BOLT
Y—PEDAL PAD SEAL
Z—CLUTCH PEDAL PAD WITH SHANK
AA—WOODRUFF KEY
BB—WASHER
CC—CROSS SHAFT
DD—TIE BAR
EE—CLUTCH CONTROL LEVER
FF—FULCRUM STUD

Figure 95—continued

starts to engage. To adjust clutch pedal free play, loosen clutch control cable yoke lock nut (N, fig. 95). Using a suitable wrench, unscrew the clutch control cable (M, fig. 95) until clutch pedal has 1¼ inch free travel.

156. Clutch Controls and Linkage
(fig. 95)

a. Removal. Loosen pedal pad clamp bolt (X); then remove clutch pedal pad (Z) with shank. Disconnect clutch pedal return spring (U). Remove clutch pedal clamp bolt (V) and remove clutch pedal (W) from cross shaft (CC). Remove two bolts, nuts, and lock washers securing frame bracket (K) to frame and remove frame bracket. Remove cotter pins and remove pedal release rod (T). Remove cotter pin and clevis pin (Q), disconnect clutch control cable yoke (P) from control tube and lever (H), and remove control tube and lever.

b. Installation. Install control tube and lever (H) and ball stud (E) on transmission and attach frame bracket (K) to frame with two bolts, nuts, and lock washers. Install pedal release rod (T) and secure with a cotter pin at each end. Connect clutch control cable (M) to control tube and lever (H) with clevis pin (Q) and cotter pin. Install clutch pedal (W) on cross shaft (CC) and secure with clutch pedal clamp bolt (V). Insert pedal pad with shank (Z) through floor board and secure with pedal pad clamp bolt (X). Adjust clutch pedal (W) free travel (par. 155).

157. Clutch Replacement

a. Coordination With Ordnance Maintenance Unit. Replacement of the clutch with a new rebuilt clutch is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation which are not carried by the using organization may be obtained from the supporting ordnance maintenance unit.

b. Removal.

(1) *Remove power plant.* Refer to paragraph 96, for power plant removal.

(2) *Remove transmission.* Refer to paragraph 160.

(3) *Remove flywheel housing.* Disconnect vent line from top of flywheel housing. Remove the eleven nuts, bolts, and lock washers securing the flywheel housing to the engine and remove flywheel housing.

(4) *Remove clutch.* Remove six cap screws and lock washers securing clutch cover plate assembly to flywheel and remove clutch cover plate assembly. Remove clutch driven disk assembly.

c. Installation.

(1) *Install clutch.* Install the clutch driven disk with short end of hub toward the flywheel; then place the clutch cover plate assembly in position. With a clutch pilot arbor tool, aline the clutch driven disk splines. Install six cap screws and lock washers; secure clutch cover plate assembly to flywheel and tighten securely. Remove clutch pilot arbor tool.

(2) *Install flywheel housing.* Position flywheel housing on engine and secure with 11 bolts, nuts, and lock washers. Connect vent line to top of flywheel housing.

(3) *Install transmission.* Refer to paragraph 161.

(4) *Install power plant.* Refer to paragraph 97.

(5) *Adjust clutch pedal free travel.* Refer to paragraph 155.

(6) *Record of replacement.* Make a record of the clutch replacement on DA Form 478 (MWO and Major Unit Assembly Replacement Record and Organizational Equipment File).

Section XVIII. TRANSMISSION

158. Description and Data

a. Description. The transmission (fig. 96) is a selective, three speed gear box with a synchronized second and high speed gears. The transmission is removed as part of the power plant (fig. 42). The gears within the transmission are shifted by a transmission gearshift lever (figs. 6 and 7) extending out of the top of the control housing and is located in the vehicle to the right of the driver. The transmission transmits the power of the engine, through the transfer to the front and rear axle assemblies.

b. Data.

Manufacturer	Warner Gear
Type	Syncromesh
Speeds	3 forward–1 reverse
Ratios:	
Low	2.798–1
Intermediate	1.551–1
High	1.000–1
Reverse	3.798–1
Lubricant capacity	2 pt

159. Coordination with Ordnance Maintenance Unit

Replacement of the transmission with a new or rebuilt unit is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation not carried by the using organization may be obtained from the supporting maintenance unit.

160. Removal

a. Remove Power Plant. Remove the power plant (par. 96).

b. Drain Transmission and Transfer. Disconnect vent line from connection on top of flywheel housing. Remove drain plugs from

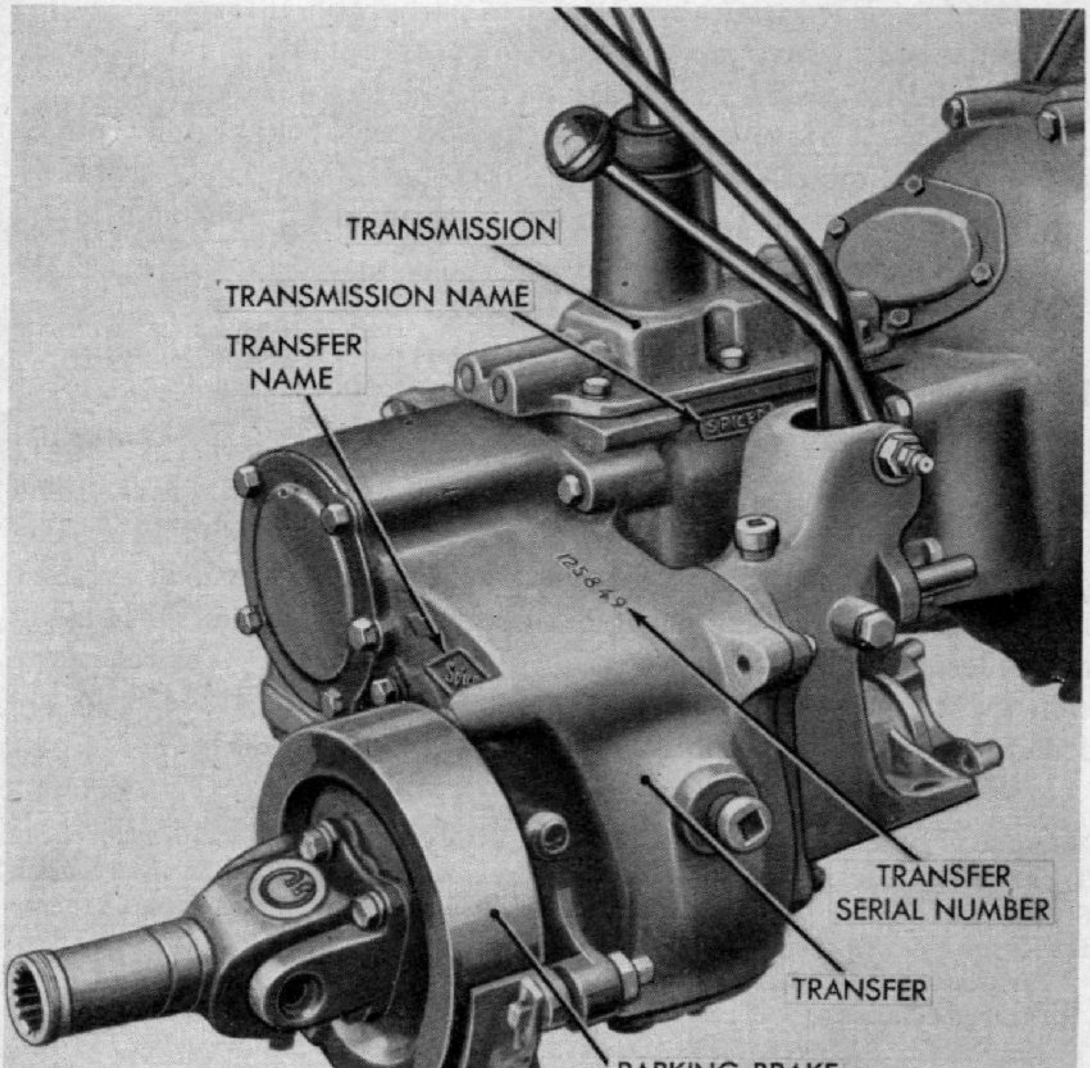


Figure 96. Transmission and transfer installed.

transmission and transfer and drain lubricant. Reinstall drain plugs when draining is completed.

c. Remove Transmission and Transfer. The transmission and transfer (fig. 96) should be separated from the flywheel housing and removed as a unit. Remove the inspection cover from the top of the flywheel housing by removing two cap screws and lock washers. Remove inspection cover gasket. Reach through inspection opening, disengage clutch release fork from release bearing and stud, and remove clutch release fork. Remove the four cap screws and lock washers, attaching the transmission to the flywheel housing. Slide transmission back carefully to clear flywheel housing of the clutch shaft. Remove transmission gasket.

d. Separate the Transmission and Transfer. When the transmission and transfer have been removed as a unit, the transfer must be removed from the transmission to effect a replacement of either unit. Remove five cap screws and lock washers securing the rear cover on the transfer and remove rear cover and gasket. Working through opening at rear of transfer remove the cotter pin, nut, and flat washer from end of transmission main shaft. Pull the main shaft gear and oil slinger from the transmission main shaft. Remove six lock washer cap screws and remove control housing and gasket from top of trans-

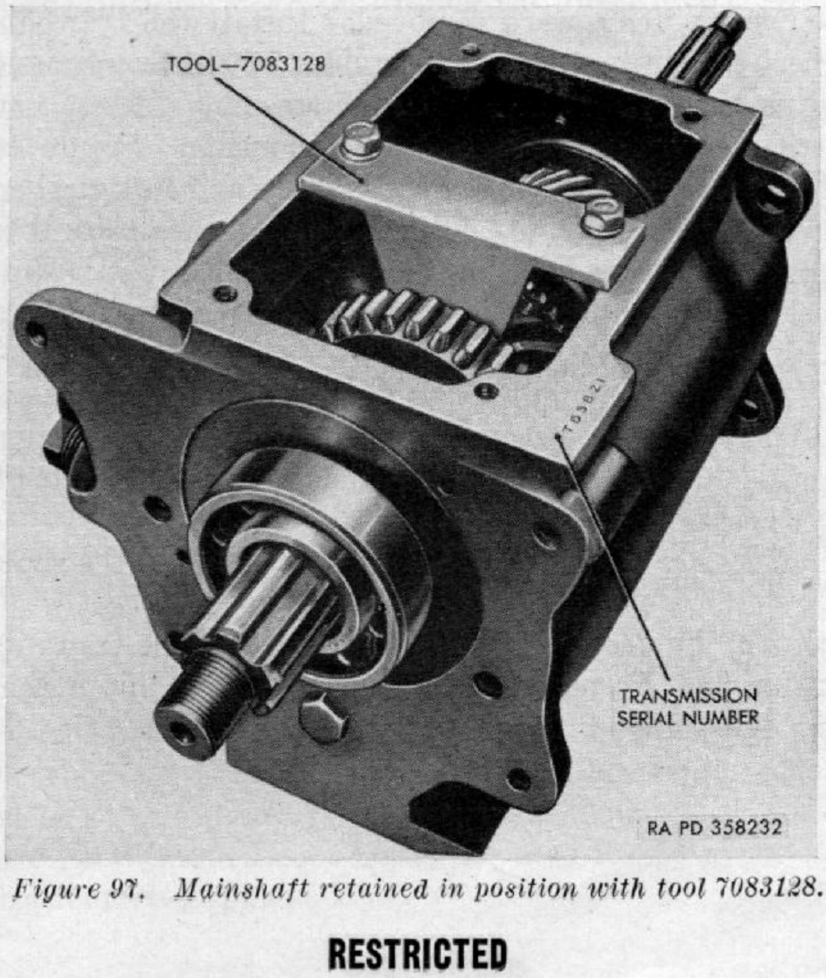


Figure 97. Mainshaft retained in position with tool 7083128.

mission. Position the retaining tool 7083128 (fig. 97) behind the second speed gear and secure to transmission case with two cap screws and lock washers. Remove the five cap screws and lock washers attaching the transfer to the transmission and separate transfer from transmission, using care that the transmission mainshaft rear bearing, which bears in both units, remains in the transmission. Remove the transfer gasket and discard.

161. Installation

a. Install Transfer on Transmission. Use a new transfer gasket between the transmission and transfer. Position the transfer on the transmission and secure with five cap screws and lock washers. Install oil slinger and main shaft gear, with the small gear facing out on the transmission main shaft. Install flat washer, nut, and cotter pin to secure main shaft gear. Install rear cover on transfer using a new gasket and secure with five cap screws and lock washers. Remove two cap screws and lock washers and remove retaining tool 7083128 (fig. 97). Position control housing on transmission case with a new gasket and secure with six lock washer cap screws.

b. Install Transmission and Transfer. Install the clutch release bearing, clutch release bearing carrier, and clutch release bearing carrier spring (A, B, and C, fig. 95) on transmission front bearing retainer if these items were removed. Install the transmission on the flywheel housing, guiding the splines of the transmission main gear shaft into the splines of the clutch assembly. Use a new gasket between the transmission and flywheel housing. Secure transmission to flywheel housing with four cap screws and lock washers, tightening cap screws securely. Install the clutch release fork through inspection opening in flywheel housing and install inspection cover with a new gasket. Secure inspection cover with two cap screws and lock washers.

c. Fill Transmission and Transfer. Remove transmission filler plug and transfer filler plugs and fill transmission and transfer with proper grade lubricant (par. 53). Connect vent line to fitting on top of flywheel housing.

d. Install Power Plant. Install the power plant in the vehicle (par. 97).

e. Record of Replacement. Make a record of the transmission replacement on DA Form 478 (MWO and Major Unit Assembly Replacement Record and Organizational Equipment File).

Section XIX. TRANSFER

162. Description and Data

a. Description. The transfer (fig. 96) is an auxiliary gear unit attached to the rear of the transmission. It is essentially, in effect, a two speed auxiliary transmission providing an additional gear reduction for any selection of the transmission gears and is also a means of engaging and disengaging power to the front axle. Shifting of the transfer is accomplished by two transfer shift levers located to the right of the transmission gearshift lever (fig. 6). Use of the transfer shift levers are explained in paragraph 41. An opening at the rear of the transfer is provided for mounting a power take-off. The parking brake (fig. 96) is mounted at the rear of the transfer on the rear axle output shaft.

b. Data.

Manufacturer	Spicer
Ratio:	
High range	1.00–1
Low range	2.43–1
Lubricant capacity	3 pt

163. Coordination with Ordnance Maintenance Unit

Replacement of the transfer with a new or rebuilt unit is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

164. Removal

Details for the removal of the transfer are covered in paragraph 160*d*. In removing the transfer, it is not usually necessary to remove the transmission from the flywheel housing. Perform all other operations in paragraph 160 which are pertinent to transfer removal.

165. Installation

Install the transfer in accordance with instructions in paragraph 161*a* omitting operations pertaining to installations of transmission to flywheel housing. Make a record of the transfer replacement on DA Form 478 (MWO and Major Unit Assembly Replacement Record and Organizational Equipment File).

Section XX. PROPELLER SHAFTS

166. Description

The propeller shafts (figs. 98 and 99), one front and one rear, are used to transmit the drive of the transfer, transmission, and engine to the front and rear axle assemblies. Each propeller shaft is equipped with a universal joint at each end to permit rotation when propeller shaft is installed with ends off-center. Each propeller shaft is equipped with a splined, sliding yoke at the end nearest the transfer to compensate for the flexing of the front and rear axles on the springs. The rear propeller shaft universal joints are of the **U** bolt and snap ring type, while the front propeller shaft universal joints are of the **U** bolt type. The rear propeller shaft is equipped with the **U** bolt type universal joint at the axle end and the snap ring type at the transfer. Both universal joints of the front propeller shaft are of the **U** bolt type.

167. Removal

a. Front Propeller Shaft (fig. 98). Remove the four safety nuts and remove **U** bolts from each end of front propeller shaft universal joint. Push the sliding yoke to collapse propeller shaft and remove from vehicle.

Note.—While removing propeller shaft, make certain that universal joint bearing rollers are not lost or damaged.

Figure 98. Front propeller shaft installed.

b. Rear Propeller Shaft (fig. 99). Remove nuts, lock washers, and bolts attaching rear universal joint yoke to parking brake drum. Remove four safety nuts and remove the **U** bolts from the rear propeller shaft universal joint. Push the sliding yoke to collapse the propeller shaft and remove from vehicle.

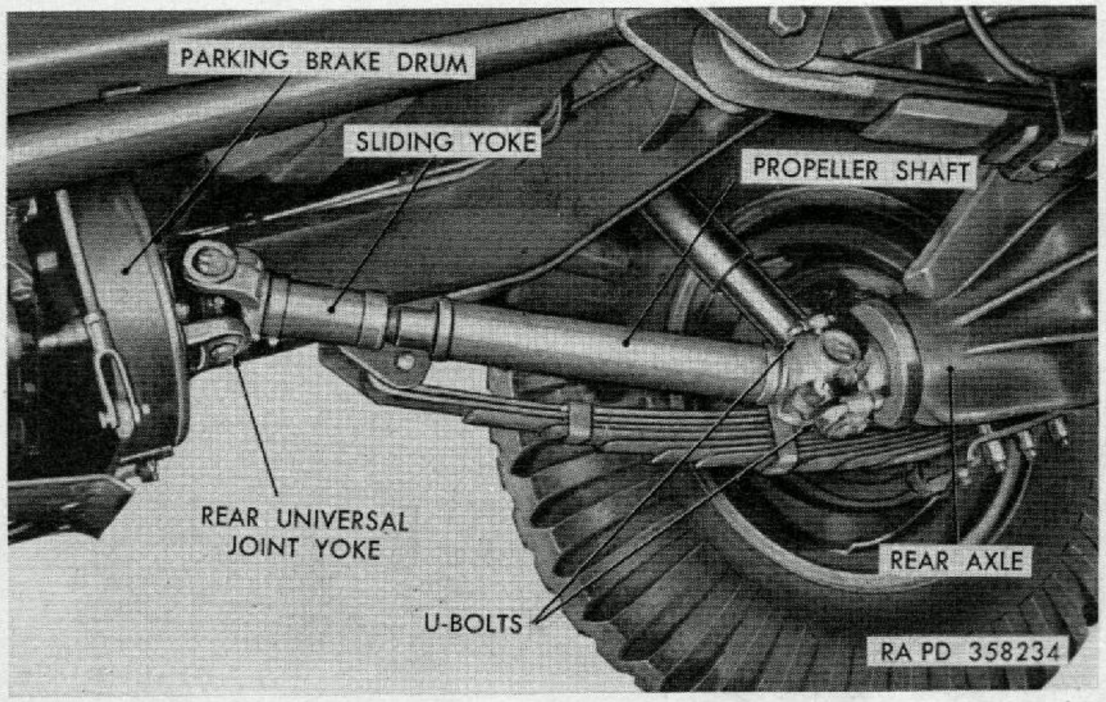


Figure 99. Rear propeller shaft installed.

168. Installation

a. Front Propeller Shaft (fig. 98). Place front propeller shaft in position and fit universal joint bearings in front axle yoke. Install two **U** bolts and secure with safety nuts. Position universal joint bearings in transfer yoke, install **U** bolts and secure with safety nuts.

Note.—Tighten **U** bolts evenly.

b. Rear Propeller Shaft (fig. 99). Place rear universal joint yoke on parking brake drum and secure with four bolts, lock washers, and nuts. Position universal joint bearings in rear axle yoke and install **U** bolts, tightening safety nuts securely.

Section XXI. FRONT AXLE

169. Description and Data

a. Description. The front axle is a hypoid, single reduction type using conventional differential and carrier assembly to transmit drive to the front wheels through constant velocity universal joints. The differential carrier housing is located off-center so that the propeller shaft from the transfer is located to the right of the engine for maximum ground clearance.

Note.—The outer end of the axle shaft floats in the drive flange splines and is not retained by a nut. End play is predetermined in manufacture. No shims are placed between the drive flange and the hub. A gasket only is used.

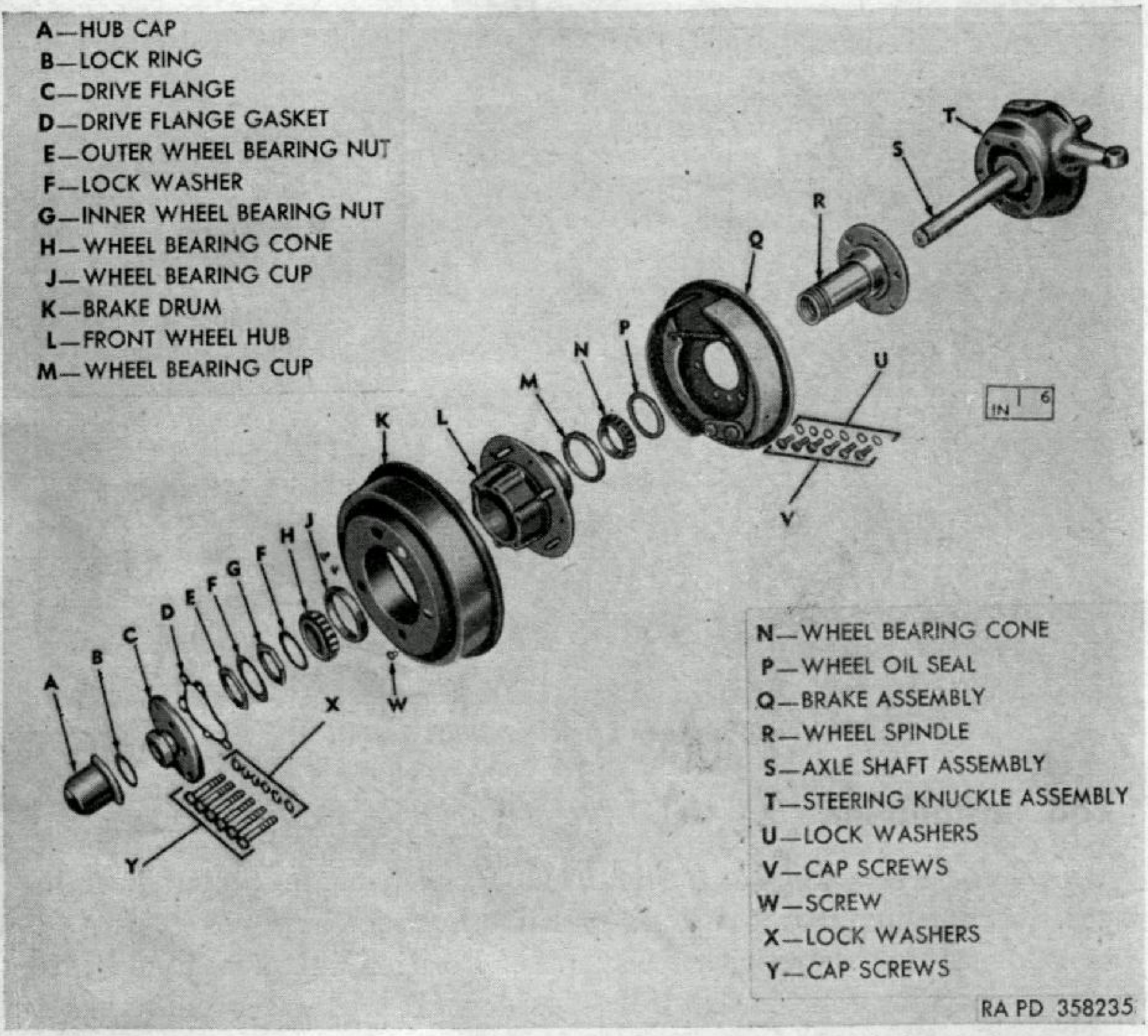


Figure 100. Front axle—exploded view.

b. Data.

Manufacturer	Spicer
Model	25
Drive gear ratio	5.38–1
Drive	Hotchkiss
Type	full floating
Differential type	2 pinion
Differential drive gear	hypoid
Differential bearings	tapered roller
Turning angle	25°
Lubricant capacity	1¼ qt
Tie rods:	
Number	2
Right-hand length, center to center	24½ in
Left-hand length, center to center	19¾ in

Steering geometry:

King pin inclination	7½°
Wheel camber	1½°
Wheel caster	3°
Wheel toe in	3/64 to 3/32 in

170. Front-Wheel and Axle Alinement
(fig. 101)

a. Alinement Factors. Front-wheel alinement factors, such as cambers, caster, turning angle, and toe-in, have a major effect on steering from a standpoint of control, ease of steering, and safety. Front wheel misalinement is a major cause of premature and uneven tire wear or unusual or abnormal wear of front wheel and axle parts.

b. Caster. Front-axle caster is the inclination of the centerline through the upper and lower steering knuckle trunnions toward the rear of the vehicle. If caster condition requires attention, notify ordnance maintenance personnel.

c. Camber. Front-wheel camber is the outward inclination of the front wheels as viewed from the front of the vehicle; that is the front wheels are farther apart at the top than at the bottom. If the condition requires attention, notify ordnance maintenance personnel; however, loose wheel bearings, loose steering knuckle trunnion bearings, bent steering knuckle, or a bent axle housing will effect camber.

d. Turning Angle. Front wheel turning angle (A) is the maximum angle through which the wheels may be turned from the straight-ahead position.

e. Toe-In. Front-wheel toe-in is the amount by which the wheels are closer together at the front than at the rear, with the wheels in the straight-ahead position (C minus B). Camber causes both front wheels to have a tendency to turn outward from the vehicle. Toe-in counteracts this tendency and causes the wheels to roll straight ahead with no scuffing action.

171. Toe-In Adjustment
(fig. 101)

a. Toe-In Check. Inflate tires to correct pressure (par. 211) and check for proper wheel bearing adjustment (par. 174). Place the vehicle on a smooth level surface with the steering bellcrank at right angles to the front axle. Use a straightedge or aline against the outside of the left wheels at right angles to the axles (fig. 101) as a guide. Measure the distance between this guide or line and the flat edge of the front wheel (D). This distance should be three sixty-fourths to three thirty-seconds of an inch.

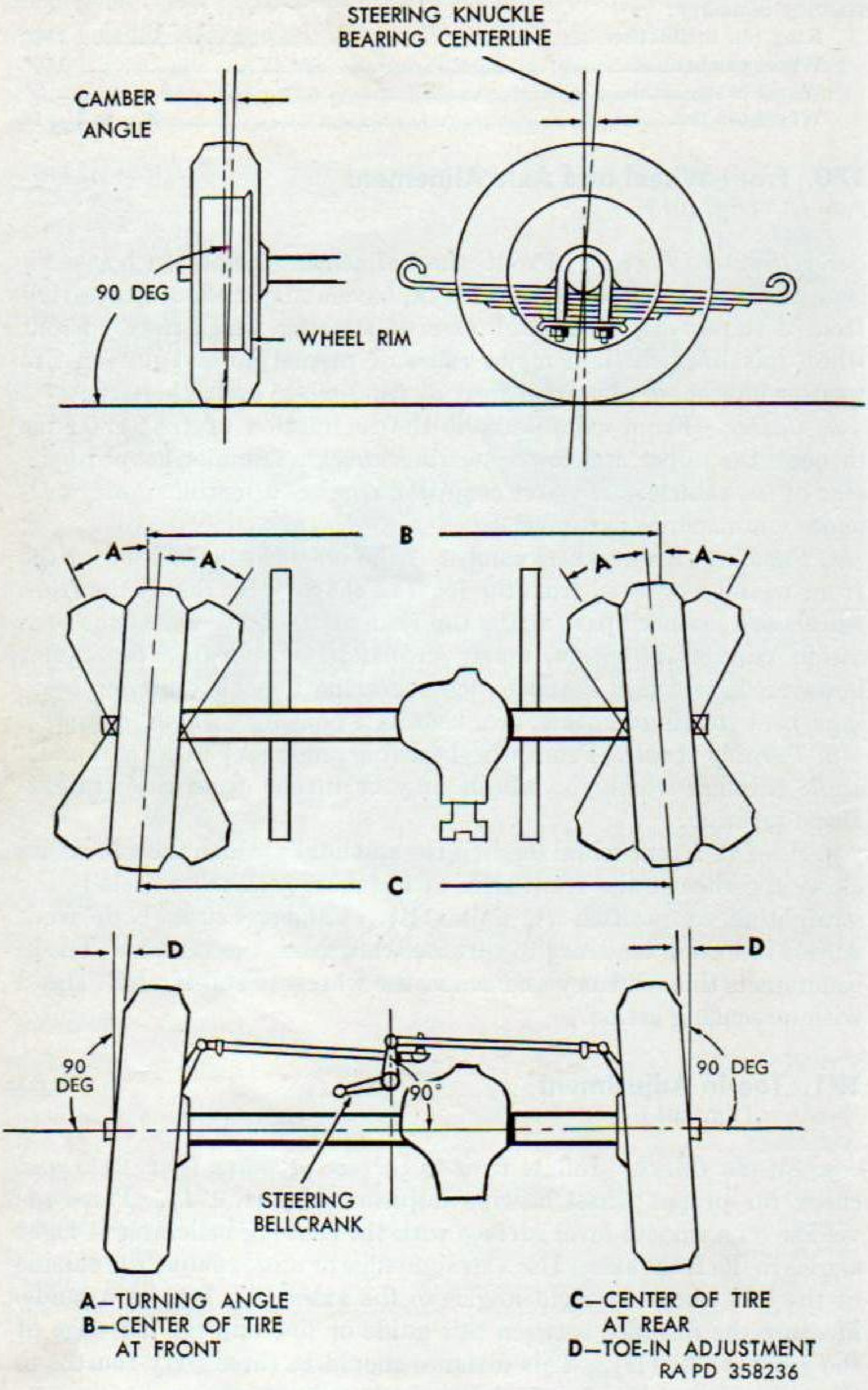


Figure 101. Front wheel and axle alinement chart.

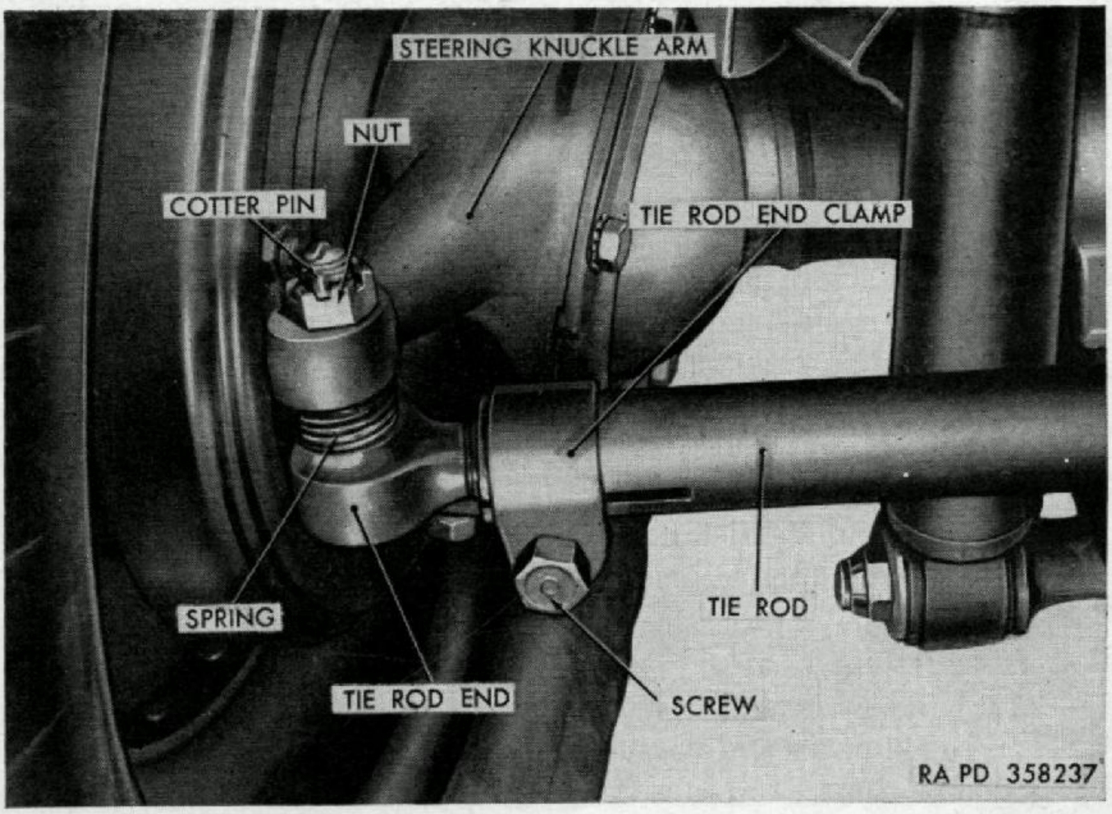


Figure 102. Tie rod end installed.

b. Toe-In Adjustment. Remove the cotter pin and nut and remove the tie rod end from the steering knuckle arm (fig. 102). Loosen the nut and screw securing the tie rod and end clamp (fig. 102), and turn the tie rod end one complete turn on or off to obtain correct toe-in measurement.

Note.—Tie rod end on right side of vehicle has left-hand threads; the one on the left side has right-hand threads.

To check toe-in, temporarily install tie rod end in the steering knuckle arm and measure toe-in. When adjustment is correct, place tie rod end in steering knuckle arm, tighten nut, and install cotter pin. Make sure tie rod end clamp is securely fastened with nut and screw.

172. Tie Rods
(fig. 103)

a. General. Both tie rods are equipped with adjustable tie rod ends having right- and left-hand threads.

b. Removal.

(1) Place vehicle on a level surface and apply parking brake.

(2) Remove cotter pin and nut securing tie rod end to either steering knuckle arm, steering bellcrank or left-hand tie rod

end. In some instances, a slight tap of a hammer will be required to loosen the tie rod end from its attached position. Remove springs and dust covers from tie rod ends.

c. Tie Rod and Replacement.

(1) In some cases, the tie rod itself may not be damaged but the tie rod ends may be worn or damaged. In this case, it is not necessary to replace the complete tie rod assembly. Loosen the nut and screw securing the tie rod end clamp to the tie rod and unscrew the tie rod end from the tie rod.

(2) Install new tie rod end in tie rod but do not install the tie rod end clamp. Place tie rod assembly in approximate position they will assume, when permanently installed to judge the approximate distance tie rod ends should be screwed into tie rod. Tighten tie rod end clamp on steering bellcrank end of tie rod.

d. Installation.

(1) Use new springs and dust covers, if inspection reveals damage to old parts, and install them on tie rod ends.

(2) Position tie rod ends in their respective units, steering knuckle arms, steering bellcrank, or left tie rod assembly and install nuts and cotter pins.

(3) Adjust toe-in (par. 171).

173. Steering Bellcrank

(fig. 103)

a. Removal.

(1) Remove cotter pin from adjusting plug in steering bellcrank end of drag link, remove adjusting plug and drag link ball seat, and lift drag link off end of steering bellcrank.

Note.—Do not lose dust cover or dust cover shield.

(2) Remove cotter pin and nut from steering bellcrank end of right tie rod assembly and tap tie rod end off the steering bellcrank.

Note.—Do not loosen spring or dust cover.

(3) Remove cotter pin in steering bellcrank stud and remove nut, dust washer, and thrust washer. Pull steering bellcrank off steering bellcrank stud. To remove steering bellcrank stud, remove thrust washer, and drive out tapered lock pin toward left front wheel. Drive steering bellcrank stud up and out of frame. Clean all parts in dry-cleaning solvent or volatile mineral spirits.

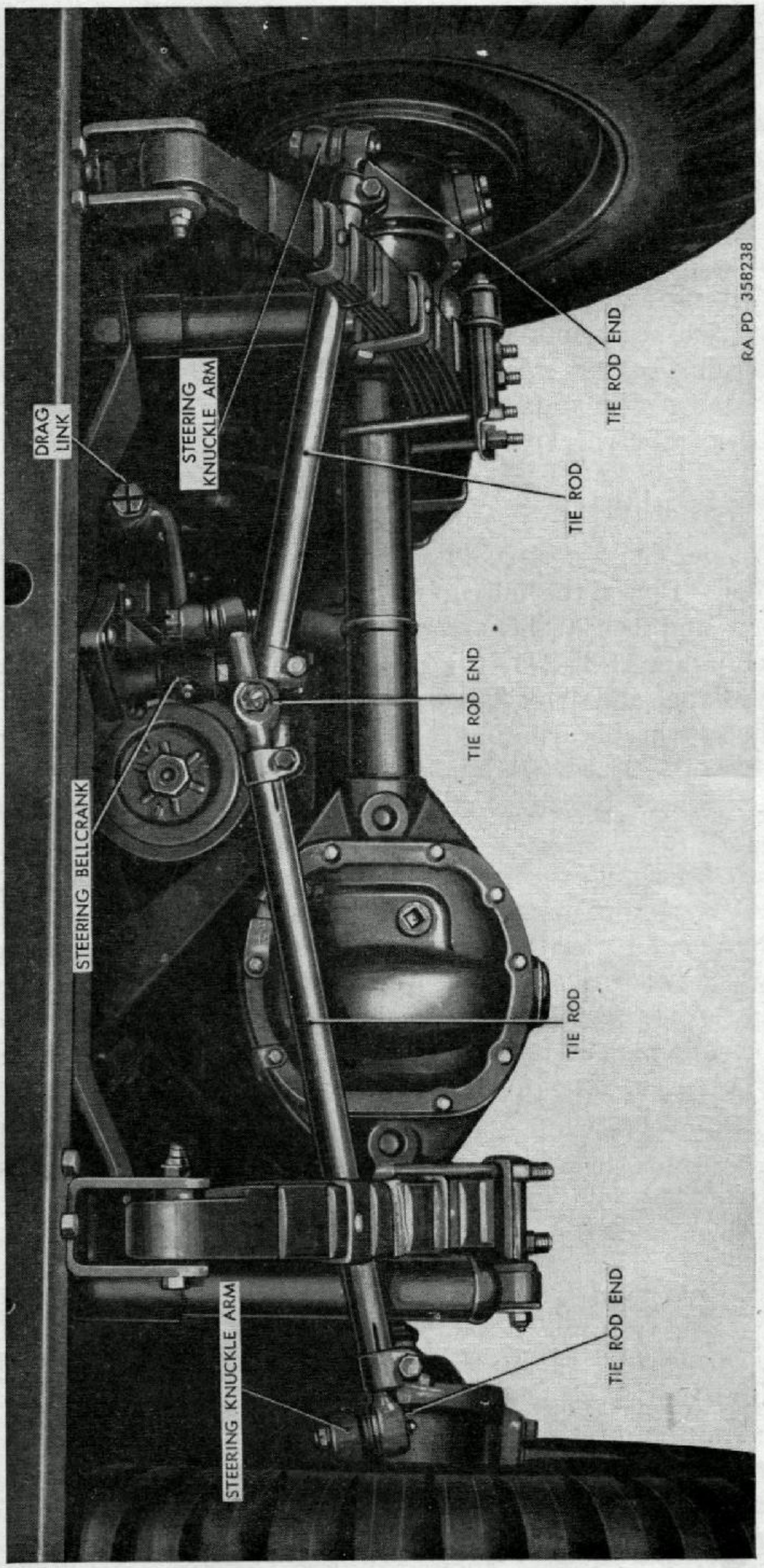


Figure 103. Tie rods and steering bellcrank installed.

b. Installation.

(1) Drive steering bellcrank stud into frame so that slot will line up with tapered lock pin hole. Drive tapered lock pin into position and stake edge of lock pin hole at large end. Install thrust washer on steering bellcrank stud. Lubricate steering bellcrank bearings and install steering bellcrank on steering bellcrank stud.

(2) Install tie rod with dust cover and spring in end of steering bellcrank, and secure with nut and cotter pin.

(3) Position drag link on steering bellcrank with dust cover and dust cover shield. Install drag link ball seat and adjusting plug, and secure with cotter pin.

(4) Check front wheel toe-in (par. 171*a*).

174. Wheel Bearings

a. Adjustment (A, fig. 100). Raise front of vehicle so that tire clears the floor. Pry off the hub cap with a suitable pry-bar. Remove six cap screws and lock washers securing drive flange to front wheel hub. Install puller 41–P–2957 (fig. 104) over lip on drive flange and remove drive flange and drive flange gasket. Bend lip of lock washer away fron outer wheel bearing nut. Remove outer wheel bearing nut with wrench 41–W–3825–200 (fig. 105). Remove lock washer from behind outer wheel bearing nut. Spin wheel and with wrench 41–W–3825–200 (fig. 105), tighten inner wheel bearing nut until wheel binds. Back off wheel bearing nut approximately one-sixth turn, or slightly more if necessary, until wheel turns freely. Install lock washer and outer wheel bearing nuts and tighten securely. Bend lip of lock washer over edge of outer wheel bearing nut. To check the wheel bearing adjustment, grip the front and rear sides of the tire and shake it from side to side. A slight perceptible movement should be felt in the bearings. Install drive flange and secure with six cap screws and lock washers.

Note.—If vehicle is equipped with Rezeppa type universal joints, disregard these instructions and install a 0.006-inch shim pack.

Install hub cap.

b. Removal.

(1) Loosen wheel stud nuts.

Note.—Wheel studs on left side of vehicle have left-hand threads.

Raise front of vehicle until tire clears floor. Remove wheel stud nuts and remove wheel.

(2) Pry off hub cap. Remove six cap screws and lock washers securing drive flange (C, fig. 100) and using puller 41–P–2957 (fig. 104) remove the drive flange.

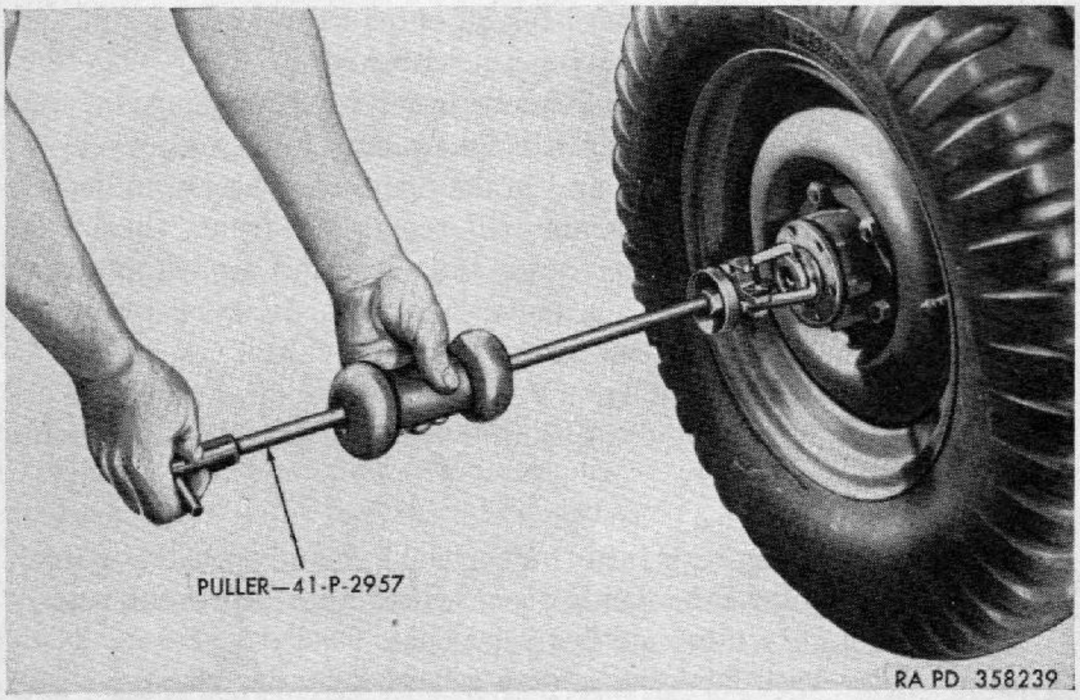


Figure 104. Removing drive flange with puller 41–P–2957.

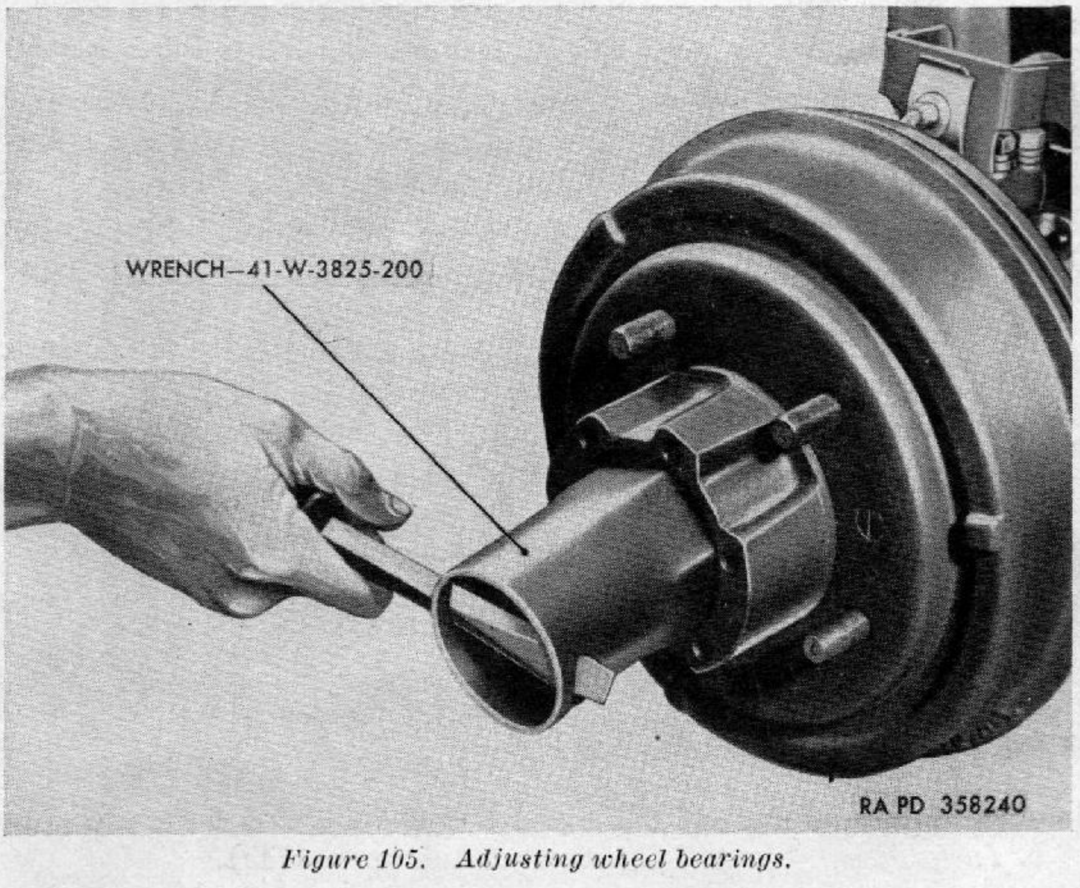


Figure 105. Adjusting wheel bearings.

(3) Bend lip of lock washer back off outer wheel bearing nut and remove outer wheel bearing nut with wrench 41–W–3825–200. Remove lock washer. Remove inner wheel bearing nut and inner lock washer in a similar manner.

(4) Pull front wheel hub and brake drum off wheel spindle (R, fig. 100). Wheel bearing will remain in front wheel hub. Remove wheel bearing cones and wheel oil seal from front wheel hub and, with a suitable driver, drive or press the wheel bearing cups out of the front wheel hub.

(5) Clean all lubricant from front wheel hub and wash all associated parts in dry-cleaning solvent or volatile mineral spirits.

c. Installation.

(1) Press bearing cups into front wheel hub and spread a $\frac{1}{16}$-inch layer of lubricant inside front wheel hub to prevent rust.

(2) Thoroughly lubricate bearing cones.

Note.—Pack lubricant between rollers of bearing cone.

Place bearing cones in bearing cups in front wheel hub and place a new wheel oil seal (with lip toward the bearing cone) in the front wheel hub until the oil seal is even with the front wheel hub.

Note.—Before installing wheel oil seal, soak in engine oil to soften leather.

(3) Install front wheel hub and brake drum on wheel spindle and install inner lock washer and inner wheel bearing nut. Adjust wheel bearings (*a* above).

(4) Install outer lock washer and outer wheel bearing nut with wrench 41–W–3825–200. Bend lip of lock washer over edge of wheel bearing nut.

(5) Install drive flange and secure with six cap screws and lock washers. Install hub cap.

(6) Install wheel and tighten stud nuts. Lower vehicle to ground and tighten stud nuts.

175. Wheel Oil Seal

a. Removal. Removal wheel oil seal (par. 174*b*).

b. Installation. Install wheel oil seal (par. 174*c*).

176. Front Wheel Hub

a. Removal. Remove front wheel hub (par. 174*b*).

b. Installation. Install front wheel hub (par. 174*c*).

177. Brake Drums

a. Removal. Remove front wheel hub and brake drum (par. 174*b*).
b. Installation. Install front wheel hub and brake drum (par. 174*c*).

178. Steering Knuckle Oil Seal
(fig. 106)

a. Removal. Raise front of vehicle. Removal eight cap screws and lock washers holding upper and lower halves of oil seal retainer to steering knuckle. Remove oil seal retainer (both halves) and lift out steering knuckle oil seal and oil seal spring.
b. Installation.

Note.—Before installing new steering knuckle oil seal, smooth spherical surface of axle with aluminum oxide abrasive cloth.

Grease spherical surface of axle and steering knuckle oil seal lightly. Position oil seal spring and new steering knuckle oil seal in oil seal retainers. Position halves of oil seal retainer against steering knuckle so that ends fit snugly together. Install eight cap screws and lock washers and tighten securely.

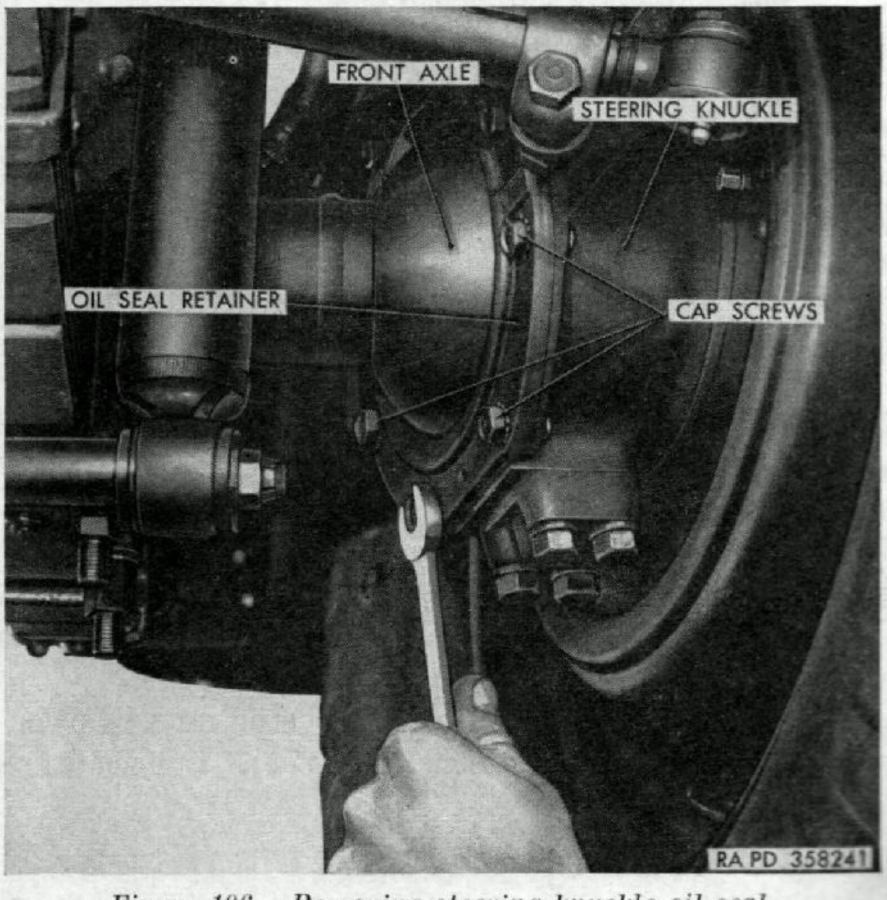


Figure 106. Removing steering knuckle oil seal.

179. Front Axle Removal

a. Coordination With Ordnance Maintenance Unit. Replacement of the front axle with a new or rebuilt unit is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation and not carried by the using organization may be obtained from the supporting ordnance maintenance unit.

b. Loosen Wheel Stud Nuts. Raise front of vehicle and support under frame side rails at rear of front spring shackle. Remove wheel stud nuts and remove front wheels.

c. Disconnect Flexible Brake Lines at Front Wheels. Disconnect tie rods from steering bellcrank (par. 172). Disconnect front propeller shaft at front axle (par. 167). Remove safety nut and flat washer and disconnect shock absorber (par. 202) from spring clip plate.

d. Using Hydraulic Jacks, Jack-Up Each End of the Front Axle. Remove nuts and lock washers from spring clips (fig. 118) and remove spring clips and spring clip plate. Place jacks at each end of the front axle to take weight off springs. Remove the spring pivot bolt (fig. 117) from the front end of the right and left spring assemblies. Lower springs to the floor and remove front axle from under the vehicle, moving it toward the front.

180. Front Axle Installation

a. From the front, slide the front axle under the vehicle and position on jacks in approximate position of installation.

b. Raise both front springs up and install pivot bolts (par. 200). Lower front axle onto springs in correct position.

c. Jack springs up to relieve tension on springs and install spring clip plates (fig. 117), spring clips, lock washers, and nuts (par. 201). Attach shock absorber to spring clip plate (par. 202). Remove jacks from under springs.

d. Connect the tie rods to steering bellcrank (par. 172). Attach front propeller shaft to front axle (par. 168). Connect flexible brake lines to front axle. Fill brake system (par. 195). Adjust brakes, if necessary (par. 191).

e. Install front wheels and tighten wheel stud nuts. Lower vehicle to ground. Check toe-in adjustment (par. 171). Lubricate front axle (par. 53).

Section XXII. REAR AXLE

181. Description and Data

a. Description. The rear axle (A, fig. 107) is of the semifloating, single reduction driving unit type, with hypoid gears. The differential housing is offset to the right to permit the propeller shaft to have a straight driving line from the rear of the transfer. The rear axle is mounted on the rear springs which transmit the forward driving force of the rear wheels.

b. Data.

Manufacturer	Spicer
Drive gear ratio	5.38 to 1
Drive	(Hotchkiss) through springs
Type	semifloating

182. Axle Shaft

a. Removal.

(1) Place a jack under the differential housing and move gear axle until tire clears floor. Remove five stud nuts and remove wheel.

(2) Pry off hub cap. Remove cotter pin and unscrew axle shaft nut (T, fig. 107) and flat washer. Using puller 41–P–2960, remove the rear hub and drum assembly (fig. 108). Remove axle shaft key from axle shaft.

(3) Remove six nuts, cap screws, and lock washers attaching grease protector, gaskets, grease and bearing retainer, shims, and the brake assembly to the rear axle (A, fig. 107). Remove the grease protector, grease retainer and two gaskets. Remove brake assembly. Remove bearing retainer and shims behind brake assembly.

(4) Pull out the axle shaft. Remove axle bearing cup and cone (D and C, fig. 107). Remove axle shaft oil seal (B, fig. 107).

b. Installation.

(1) Install axle shaft oil seal, and bearing cone and cup in rear axle (A, fig. 107). Insert axle shaft (G, fig. 107) in axle housing, rotating axle shaft so it will enter differential side gear, using care so it will not damage inner oil seal.

(2) Install bearing shims bearing retainer and brake assembly. Install gasket grease retainer, gasket and grease protector, and secure with six cap screws, lock washer, and nuts. Test axle shaft bearing adjustment (par. 183).

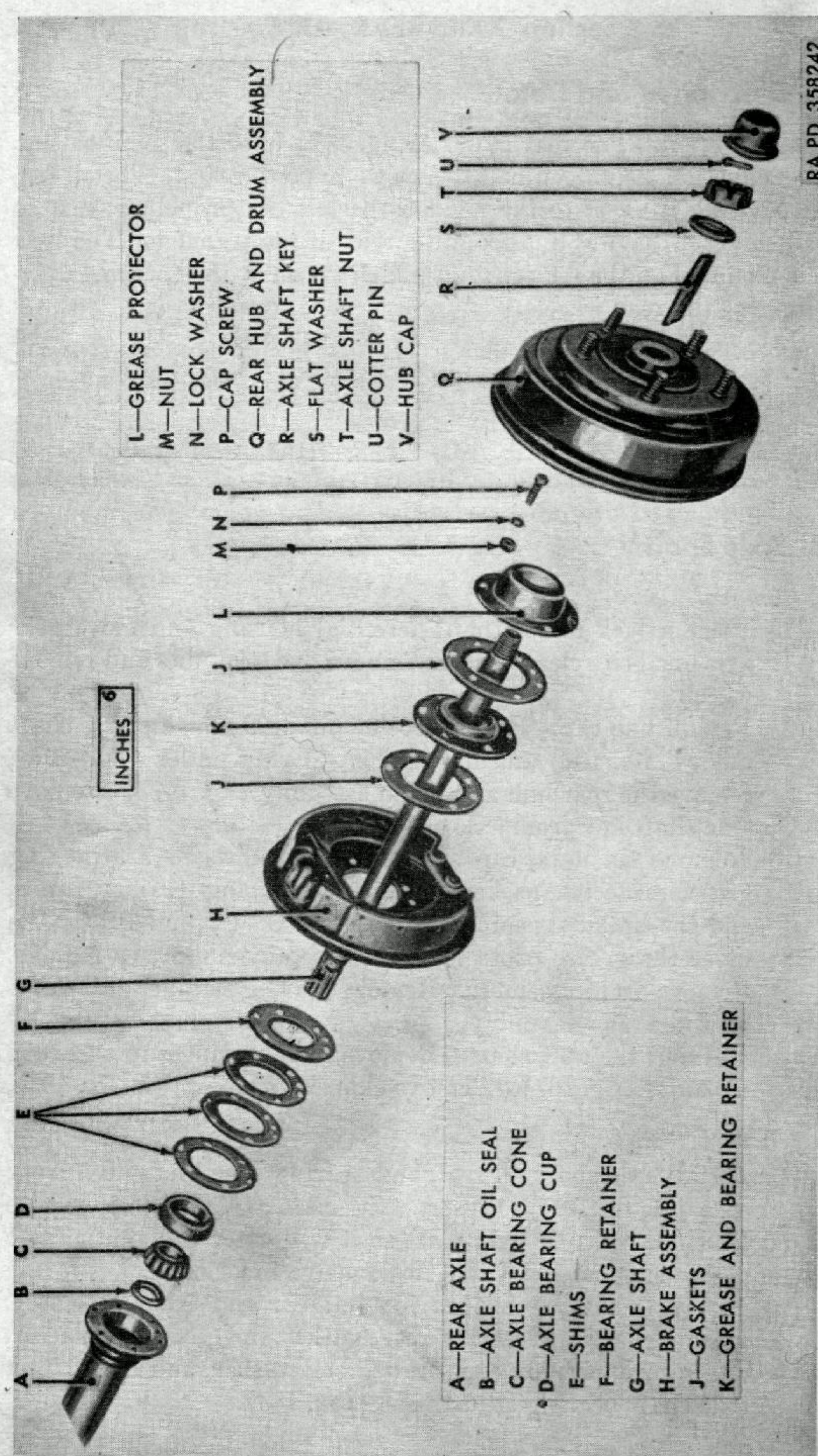


Figure 107. Rear axle—exploded view.

(3) Install rear hub and drum and axle shaft, making certain slots for key and shaft are alined; install axle shaft key. Tap hub and drum on axle shaft with a mallet. Install flat washer, axle shaft nut, and cotter pin. Install hub cap.

(4) Install rear wheel on hub and drum and tighten stud nuts securely. Lower vehicle to floor.

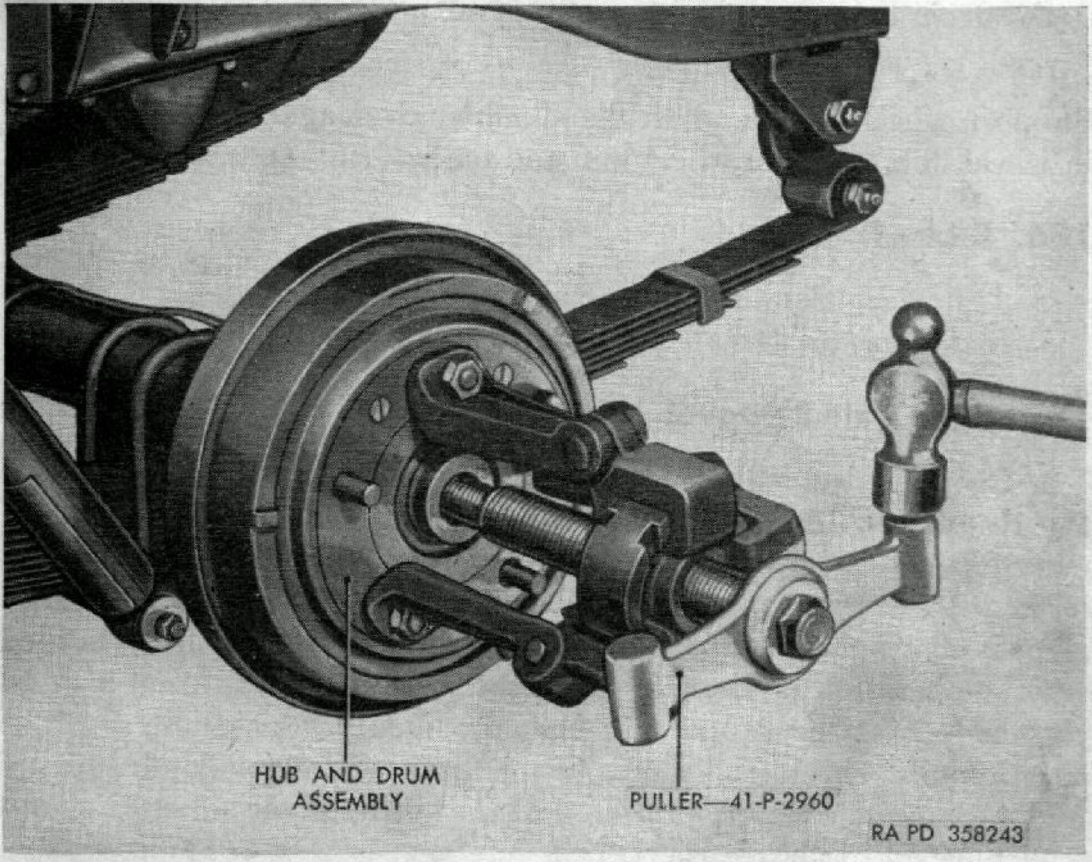


Figure 108. Removing hub and drum assembly.

183. Axle Shaft Bearings

a. Adjustment. Remove the hub and drum assembly (par. 182*a*). With the hands, test the end play by moving the axle shaft in and out. If bearings are correctly adjusted, end play of the axle shaft will be just perceptible. The adjusting shims (fig. 107) are placed between the brake backing plate and the axle flange (fig. 107). Remove or install shims (par. 182*a*) to adjust axle bearings to provide 0.003-inch to 0.007-inch end play of axle shaft.

b. Removal. Remove axle shaft bearings (par. 182*a*).

c. Installation. Install axle shaft bearings (par. 182*b*).

184. Axle Bearing Grease Retainer

a. Removal. Remove axle bearing grease retainer (par. 182*a*).

b. Installation. Install axle bearing grease retainer (par 182*b*).

185. Wheel Hub

a. Removal. Remove wheel hub and brake drum (par. 182*a*). To remove wheel hub from brake drum, support brake drum at wheel hub and drive out wheel studs and separate wheel hub and brake drum.

b. Installation. Place brake drum on hub. Using new wheel studs, drive the wheel studs into brake drum and wheel hub.

Note.—Left-hand threads are used in wheel studs on left side of vehicle.

Support wheel studs and wedge shoulder over against tapered hole in wheel hub. Install wheel hub and brake drum (par. 182*b*).

186. Brake Drum

a. Removal. Remove brake drum (par. 182*a*).

b. Installation. Install brake drum (par. 182*b*).

187. Rear Axle Removal

a. Coordination with ordnance maintenance unit. Replacement of the rear axle with a new or rebuilt unit is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the supporting ordnance officer. Tools needed for the operation and not carried by the using organization may be obtained from the supporting ordnance maintenance unit.

b. Loosen wheel stud nuts. Raise rear of vehicle and support under frame side rail just forward of the spring pivot bolts. Remove stud nuts and remove wheels.

c. Disconnect rear universal joint at rear axle (par. 167). Disconnect brake line at frame cross member. Remove brake line at axle.

d. Place a hydraulic jack under each spring. Disconnect shock absorber at spring clip plate (par. 202). Remove nuts, lock washers, spring clips, and spring clip plates (fig. 118).

e. Remove jacks from under srings and place between spring and frame; spread spring until outer end of axle can pass between spring and frame. Slide axle assembly to the right and remove.

188. Rear Axle Installation

a. With springs spread, install axle assembly between spring and frame. Remove jacks from between spring and frame and place under springs.

b. Install spring clips, spring clip plate, and nuts (fig. 118) and lock washers. Connect shock absorber to spring clip plate (par. 202). Tighten all nuts securely. Remove jacks from under springs.

c. Attach rear propeller shaft to rear axle (par. 168). Attach brake line at axle and at frame cross member. Check axle lubricant.

d. Fill master cylinder and bleed brake system (par. 195). Adjust brakes, if necessary (par. 191). Install wheels and tighten stud nuts. Lower vehicle to floor.

e. Record of replacement. Make a record of the transmission replacement on DA Form 478 (MWO and Major Unit Assembly Replacement Record and Organizational Equipment File).

Section XXIII. BRAKE SYSTEM

189. Description and Data

a. Description.

(1) *Service brakes.* The service or foot brake system (fig. 109) is of the hydraulic type with brakes on all four wheels. The brakes are of the floating two-shoe design. The service brake pedal (BB, fig. 6), through a connection, operates a piston in the brake master cylinder to force brake fluid through the brake lines to the brake wheel cylinders in each wheel. Fluid enters the brake wheel cylinders between two pistons of equal diameter, forcing them apart to apply the brake shoes against the brake drums. Releasing the service brake pedal permits the brake fluid to flow back through the brake lines to the brake master cylinder. Adjustments are provided on all four wheels to compensate for brake lining wear.

(2) *Parking brake.* The parking brake (fig. 96) is mounted at the rear of the transfer and is designed for parking the vehicle or as an emergency brake. The parking brake is controlled by the parking brake control handle (U, fig. 6) in the driver's compartment. Pulling on the parking brake control handle, forces the brake shoes of the parking brake against the brake drum.

b. Data.

Service brakes:	
Type	hydraulic
Size	9 x 1¾ in
Fluid capacity	½ pt
Master cylinder:	
Type	reservoir and cylinder
Size	1 in
Wheel brake cylinders:	
Type	straight bore
Size	1 in front, ¾ in rear

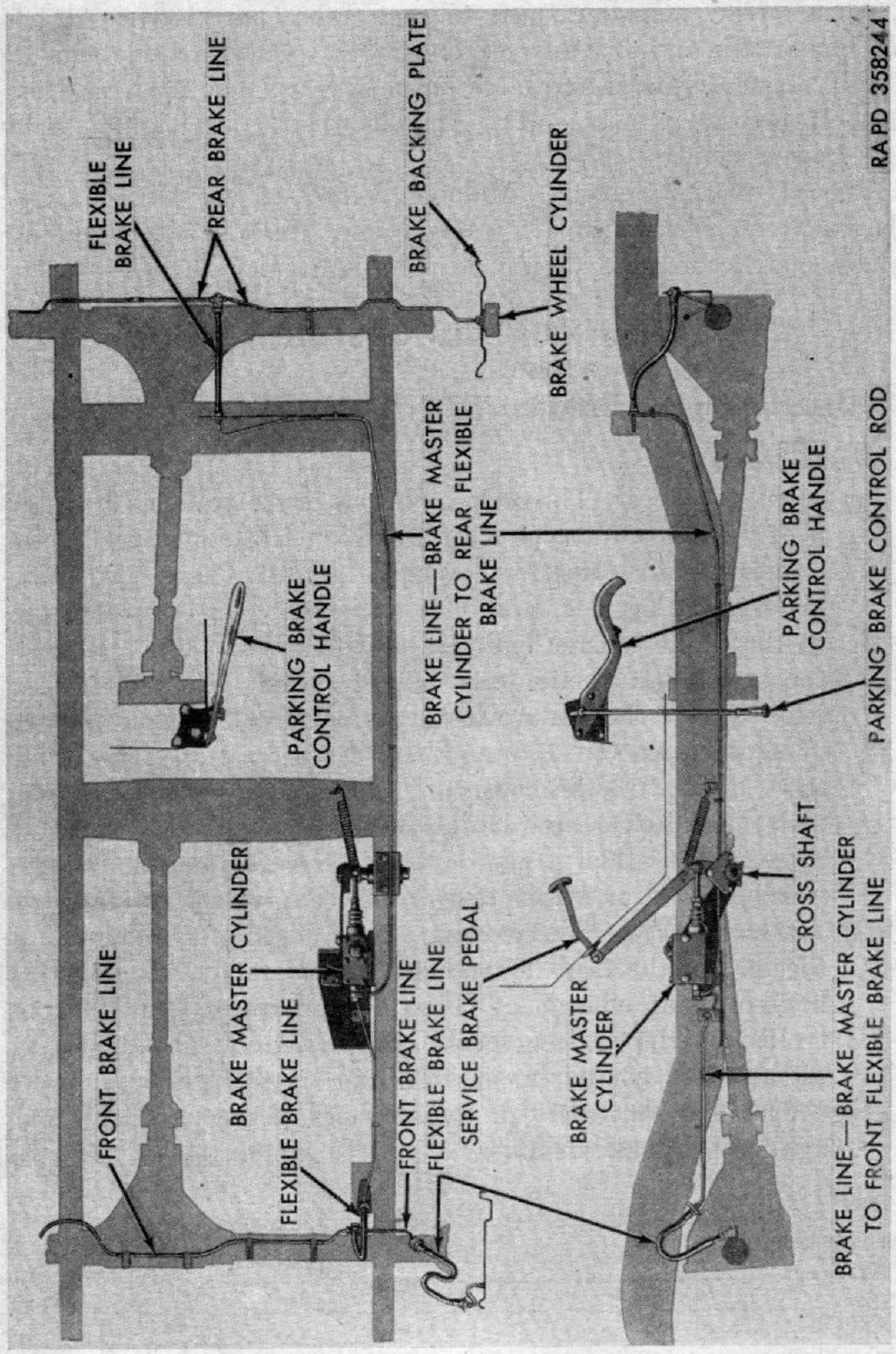


Figure 109. Brake system.

Brake shoes:
- Lining length-forward shoes .... $10\frac{7}{32}$ in
- Lining length-reverse shoes .... $6\frac{39}{64}$ in
- Width .... $1\frac{3}{4}$ in
- Thickness .... $\frac{7}{32}$ in

Parking brake:
- Type .... mechanical-internal expanding and external clamping
- Width .... $1\frac{1}{2}$ in
- Thickness .... $\frac{5}{32}$ in

190. Maintenance

The service brake system requires periodic checking of the brake fluid supply in the brake master cylinder. The brake fluid level should be kept constant to avoid air entering the hydraulic system. Wheel must be adjusted to provide for emergency stops. All brake lines and connections must be tight and leakproof. Scored brake drums or saturated or worn brake linings must be replaced. Clean brake drums when they are removed. Brake eccentric adjusting bolt lock nuts must be kept tight. Brake backing plate cap screws and axle spring clips must be kept tight. Brake pedal must have ½-inch free travel to assure full release of brake shoes. Brake control linkage must be free to operate and should be inspected periodically for condition.

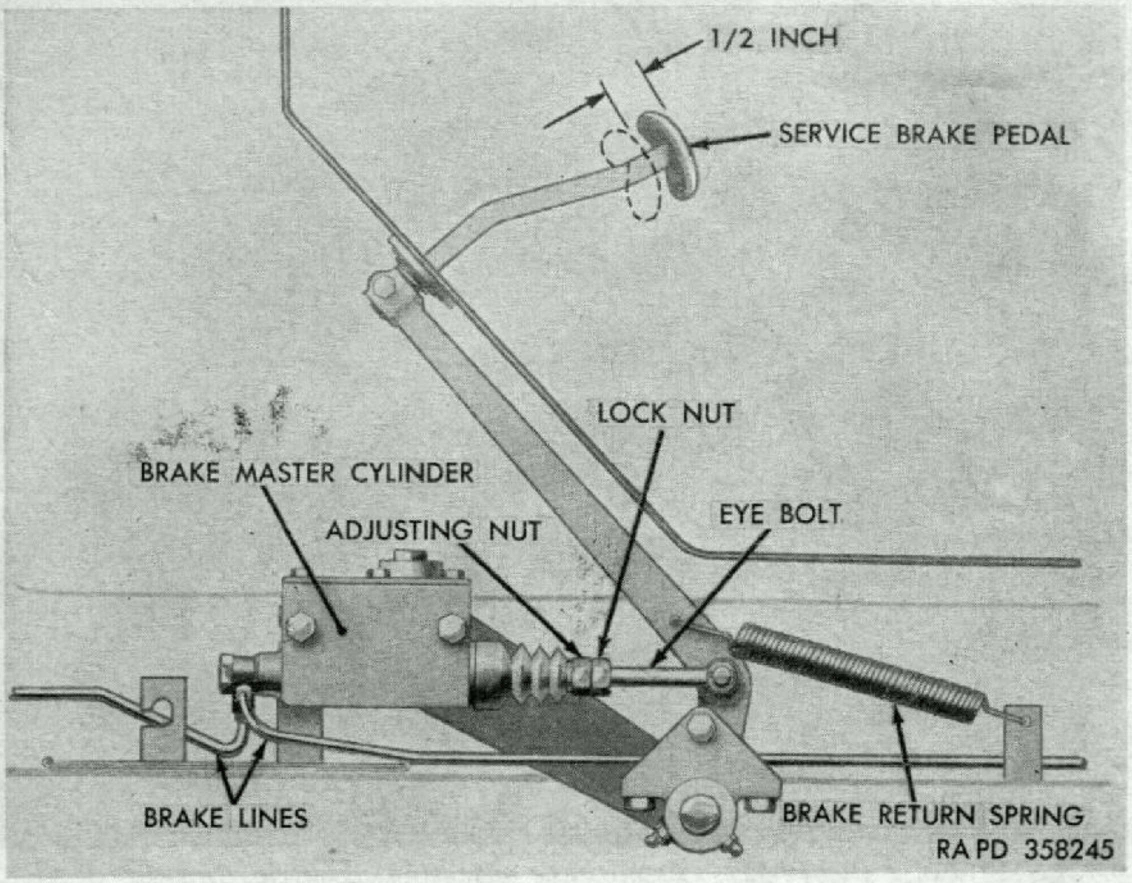


Figure 110. Brake pedal adjustment.

191. Service Brakes

a. Adjustment. Adjust brake pedal free play to one-half inch by lengthening or shortening the eye bolt (fig. 110). The eye bolt is lengthened or shortened by loosening the lock nut and turning the adjusting nut in the direction necessary to adjust the brake pedal free play to one-half inch. After brake pedal has been adjusted, secure with lock nut (fig. 110). Raise vehicle until tires clear floor.

Note.—Do not adjust brakes while brake drums are hot.

Loosen eccentric lock nut (fig. 111) on forward brake shoe of one brake. Place wrench 41–W–986 on adjusting eccentric (fig. 112) so that handle of wrench extends upward. Rotate wheel and turn wrench handle forward, until brake shoe drags. Turn wrench in opposite direction just enough to permit wheel to rotate freely. Hold wrench on adjusting eccentric and tighten eccentric lock nut. Loosen eccentric lock nut on reverse brake shoe. Place wrench 41–W–986 on adjusting eccentric (fig. 112) with handle pointing upward. Rotate wheel and turn wrench toward the rear, until the brake shoe drags. Turn wrench in opposite direction until wheel turns freely. Hold wrench on adjusting eccentric and tighten eccentric lock nut. Repeat this adjustment on all other brakes. Replenish brake fluid in brake

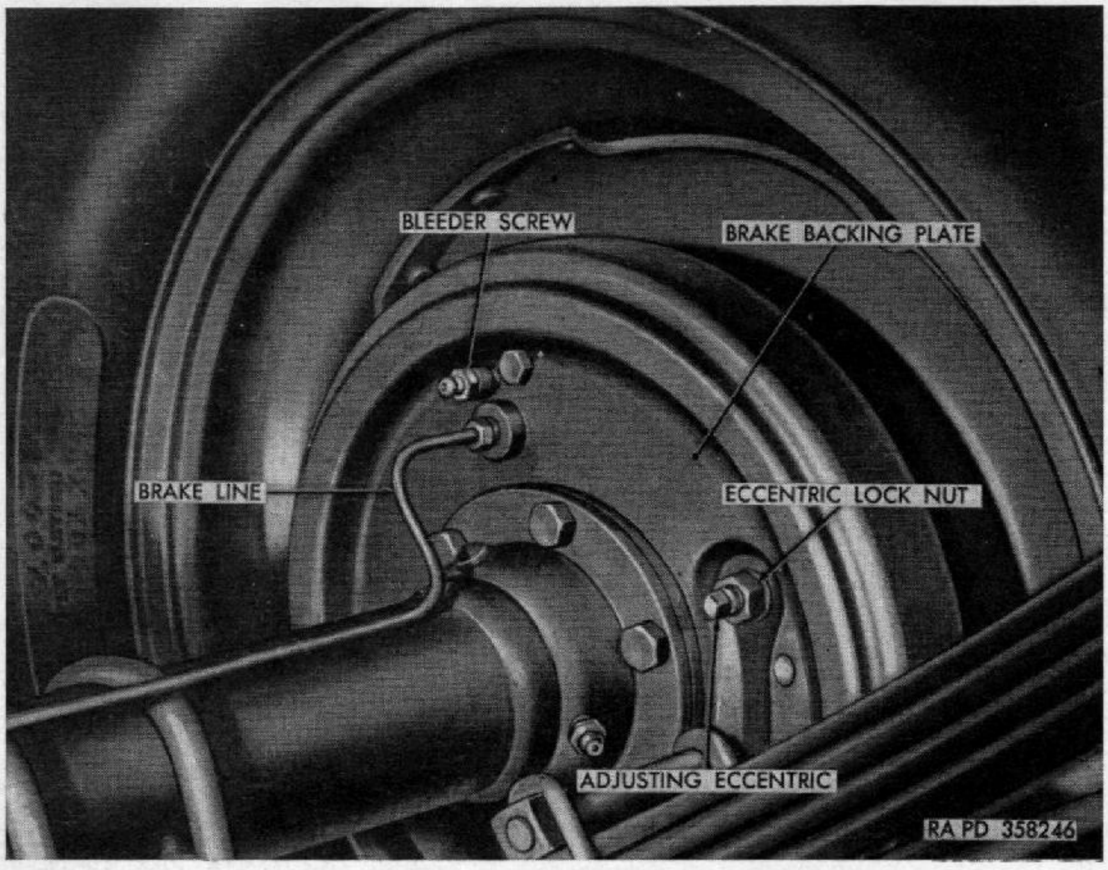


Figure 111. Brake shoe adjusting eccentric.

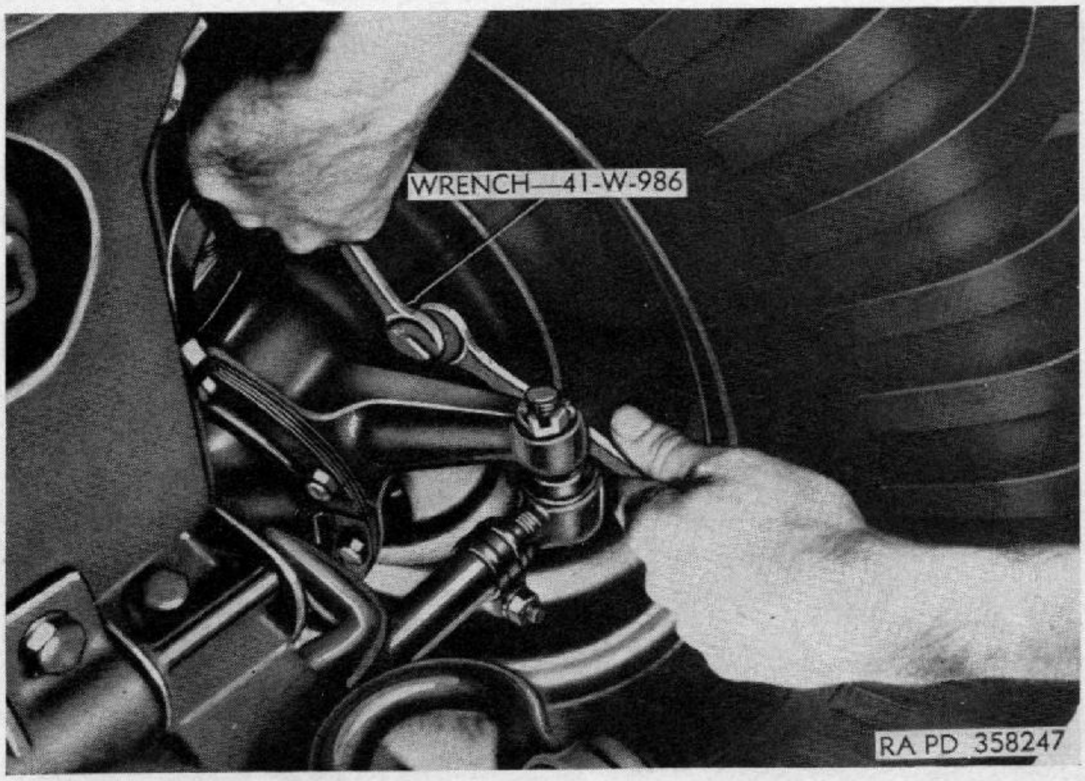


Figure 112. Adjusting brakes with wrench 41–W–986.

master cylinder (par. 195). Lower vehicle to floor and test operation of brakes.

b. Removal of Brake Shoes (fig. 113).

(1) Raise vehicle until tires clear floor. Remove stud nuts and remove wheels. Remove wheel hubs (pars. 176 and 185).

(2) Loosen eccentric lock nuts (fig. 111) and with wrench 41–W–986 turn adjusting eccentric so that low side is against brake shoe. Install a clamp over brake wheel cylinder to hold pistons in place.

(3) Remove brake shoe return spring from each brake shoe. Remove brake shoe retainer spring from lever ends of each brake shoe. Turn brake shoe hold-down spring pin until slot in brake shoe hold-down spring is alined with flat section of brake shoe hold-down spring pin and pull brake shoe hold-down springs off both brake shoes.

(4) Disengage brake shoes from brake wheel cylinder at the top and the brake shoe retainer plate at the bottom and lift out both brake shoes. Inspect exterior of brake wheel cylinder. If brake fluid leakage is apparent, replace brake wheel cylinder.

c. Installation of Brake Shoe (fig. 113).

(1) Install brake shoes on brake backing plate, inserting the brake shoe hold-down spring pin through holes in brake

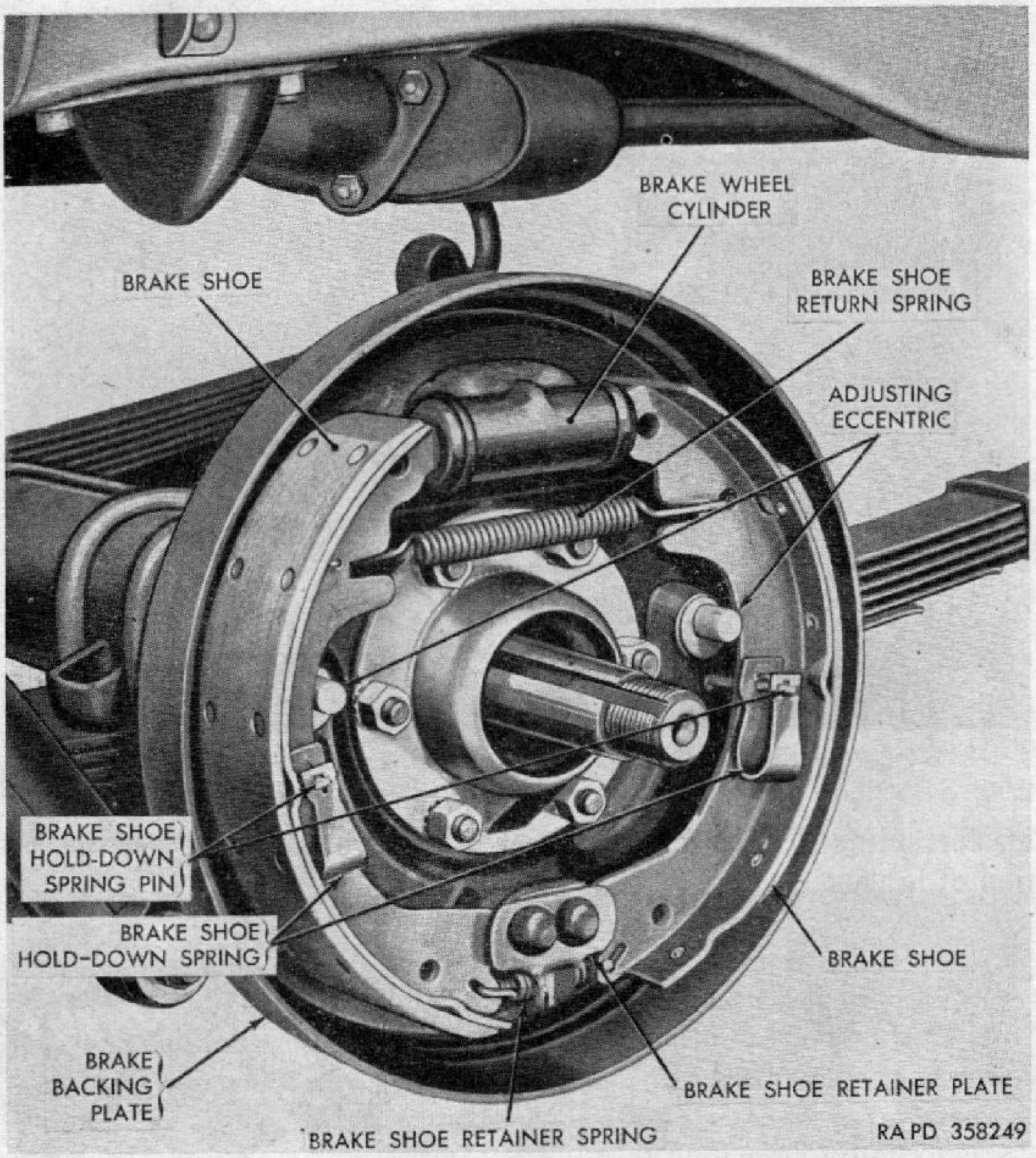


Figure 113. Brake assembly with brake drum removed.

shoes. Engage the upper end of the brake shoes in the brake wheel cylinder and the lower end in the brake shoe retainer plate.

(2) Install brake shoe hold-down spring over brake shoe hold-down spring pin, compress, and turn brake shoe hold-down spring pin to secure spring.

(3) Install brake shoe retainer springs on lower end of brake shoes. Install brake shoe return spring. Install wheel hubs (pars. 176 and 185).

(4) Adjust brakes (*a* above). Lower vehicle to floor.

192. Brake Master Cylinder
(fig. 114)

a. Removal. Remove battery cover (fig. 77) and disconnect battery ground cable (fig. 78). Remove brake master cylinder inspection cover (K, fig. 37) and cover gasket. Remove vent line from top of brake master cylinder. Remove stop light switch (par. 148). Remove outlet fitting bolt and remove outlet fitting. Remove front mounting screw attaching brake master cylinder to frame. Remove cotter pin and clevis pin attaching eye bolt to brake pedal. Remove cotter pin securing master cylinder tie bar to brake shaft. Remove rear mounting cap screw, brake master cylinder, and master cylinder tie bar from vehicle.

b. Installation. Install master cylinder tie bar and rear mounting screw on brake master cylinder and install brake master cylinder on frame, fitting master cylinder tie bar on brake shaft. Install cotter pin in brake shaft. Install eye bolt and attach to brake pedal with clevis pin and secure with cotter pin. Install front mounting screw and tighten. Position outlet fitting and install outlet fitting bolt.

Note.—Make certain gasket between outlet fitting and brake master cylinder is in good condition.

Install stop light switch (par. 148). Connect vent line to top of brake master cylinder. Bleed brakes (par. 195). Install brake

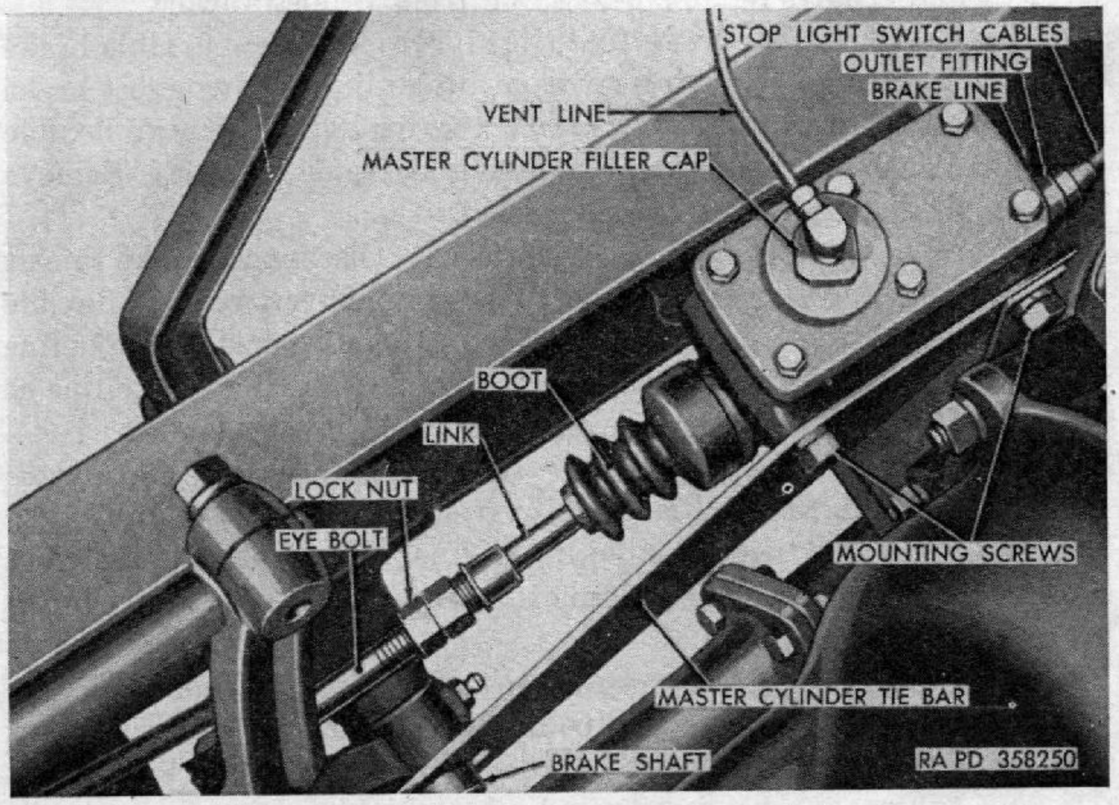


Figure 114. Brake master cylinder installed.

master cylinder inspection cover and cover gasket. Connect battery ground cable to battery and install battery cover. Adjust brake pedal free travel (par. 191*a*).

193. Brake Wheel Cylinder

a. Removal. Remove wheel (par. 210). Remove wheel hub (pars. 176 and 185). Remove brake shoe return spring. Spread brake shoes until they are clear of brake wheel cylinder. Disconnect brake line at brake backing plate. Remove two cap screws and lock washers securing brake wheel cylinder to brake backing plate and remove.

b. Installation. Place brake wheel cylinder on brake backing plate, and attach with two cap screws and lock washers. Attach brake line at brake backing plate. Fit brake shoes in slots of brake wheel cylinder pistons. Install brake shoe return spring to each brake shoe. Install wheel hub (pars. 176 and 185). Install wheel and secure with stud nuts. Bleed brakes (par. 195). Lower vehicle to floor and test operation of brakes.

194. Flexible Lines, Solid Lines, and Connections

a. Removal.

(1) *Flexible brake line at front wheels.* Remove brake line connections at each end of flexible brake line (fig. 109). With a screw driver, slip flexible line lock off ends of line fitting, and remove flexible brake line from frame bracket.

(2) *Front flexible brake line* (fig. 109). Unscrew flexible brake line from "T" fitting on front brake line. Disconnect brake line at frame bracket. With a screw driver, remove flexible line spring lock from line fitting at frame bracket. Remove flexible line from frame bracket.

(3) *Rear flexible brake line* (fig. 109). Disconnect brake line at frame cross member. With a screw driver, remove flexible line spring lock from line fitting. Remove flexible brake line from frame cross member. Disconnect flexible brake line at "T" fitting on rear axle and remove flexible brake line.

(4) *Brake line—brake master cylinder to front flexible brake line* (fig. 109). Remove clip from frame. Disconnect brake line from front flexible brake line. Disconnect brake lines from outlet fitting on brake master cylinder and remove brake line.

(5) *Brake line—brake master cylinder to rear flexible brake line* (fig. 109). Remove clips on frame side rail and rear cross member. Disconnect brake line at rear flexible brake line. Remove brake master cylinder shield. Disconnect brake

line at outlet fitting on brake master cylinder and remove brake line toward rear of vehicle.

(6) *Front brake line (both sides)* (fig. 109). Disconnect brake line at flexible brake line to front wheel brake cylinders. Disconnect brake line at "T" fitting on front axle. Remove brake line from clips on front axle and remove brake line.

(7) *Rear brake line (both sides)* (fig. 109). Disconnect brake line at rear brake backing plate. Disconnect brake line at "T" fitting on rear axle and remove brake line.

b. Installation.

Note.—It is advised that when replacing brake lines or connections, the brake should be bled of old brake fluid and new brake fluid added (par. 195).

(1) *Flexible brake line (fig. 109) at front wheels.* Place flexible brake line in frame bracket and drive flexible line locks on line fitting. Attach flexible brake line to brake line and brake wheel cylinder.

(2) *Front flexible brake line* (fig. 109). Connect lower end of flexible brake line to "T" fitting on front axle. Insert flexible line fitting into frame bracket and drive flexible line lock on line fitting. Attach brake line to flexible brake line.

(3) *Rear flexible brake line* (fig. 109). Connect flexible brake line to "T" fitting on rear axle. Insert flexible line fitting into frame cross member and drive flexible line lock over line fitting. Connect brake line to flexible brake line.

(4) *Brake line brake master cylinder to front flexible brake line* (fig. 109). Connect brake line to outlet fitting on brake master cylinder. Connect brake line to front flexible brake line. Install clip on frame side rail.

(5) *Brake line brake master cylinder to rear flexible brake line* (fig. 109). Install brake line from the rear and connect to outlet fitting on brake master cylinder. Install master cylinder shield. Install brake line in frame cross member and connect to rear flexible brake line.

(6) *Front brake line (both sides)* (fig. 109). Connect brake line to fitting on front axle. Install brake line in clips on front axle and connect brake line to fittings on brake wheel cylinders.

(7) *Rear brake line (both sides)* (fig. 109). Connect brake lines to "T" fitting on rear axle. Connect brake line to fittings on brake wheel cylinders.

195. Bleeding Brakes

a. Remove Inspection Cover. Remove four cap screws and lock washers securing brake master cylinder inspection cover (fig. 37) to floor pan, and remove inspection cover and gasket. Reach through hole and clean area around master cylinder filler cap (fig. 114).

b. Fill Brake Master Cylinder. Disconnect vent line (fig. 114) on top of master cylinder filler cap. Remove master cylinder filler cap and cap gasket and fill brake master cylinder with brake hydraulic fluid. Install master cylinder filler cap and cap gasket temporarily.

c. Bleed Brakes. Clean all bleeder screws (fig. 111) at brake backing plate. Attach a bleeder hose to bleeder screw on right rear wheel and place free end of bleeder hose in a glass jar or bottle so that end is submerged in brake hydraulic fluid. Open bleeder screw a three-quarter turn. Depress the brake pedal by hand, allowing it to return slowly. Continue this pumping action until air bubbles cease to appear at end of bleeder hose in glass jar. Follow this procedure on the right front brake, left rear brake, and left front brake.

d. Install Master Cylinder Filler Cap. Remove master cylinder filler cap and cap gasket and refill brake master cylinder with brake hydraulic fluid. Install master cylinder filler cap and cap gasket, and connect vent line. Install brake master cylinder inspection cover and cover gasket, and secure with four cap screws and lock washers.

196. Parking Brake

(fig. 115)

a. Adjustment. Place parking brake control handle (U, fig. 6) in

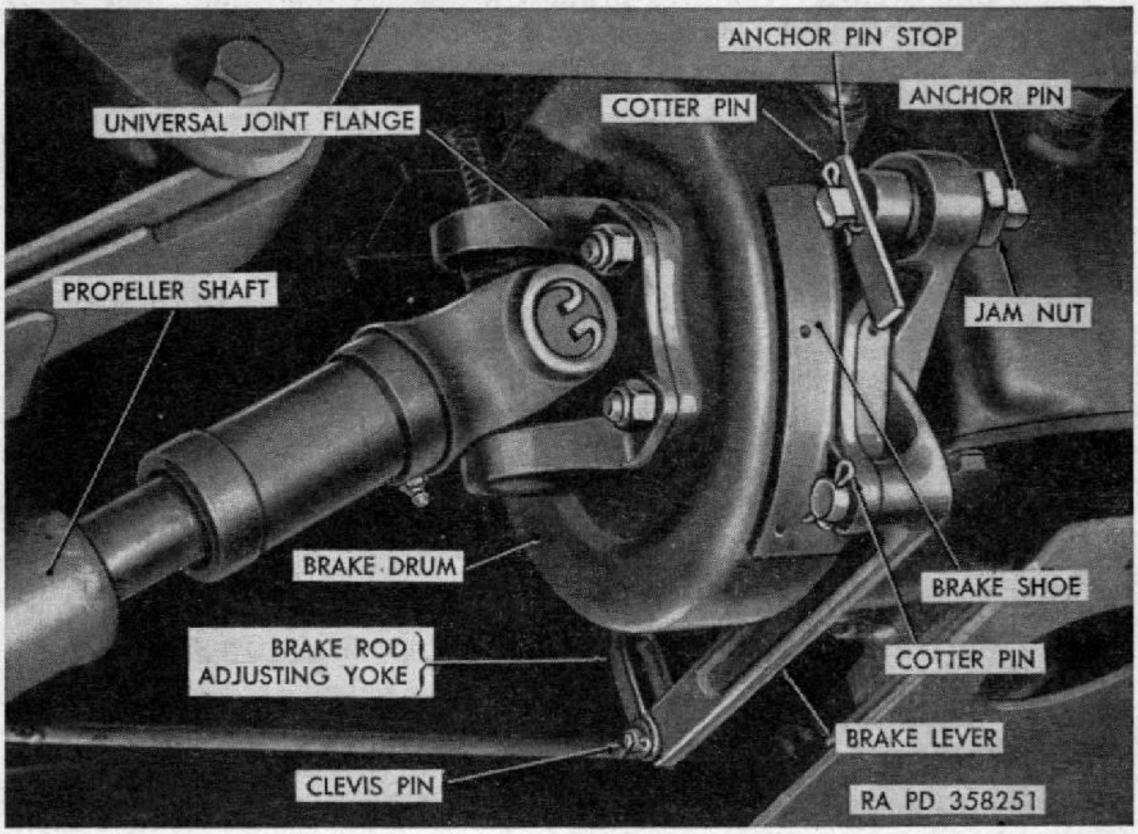


Figure 115. Parking brake installed.

fully released position. Check brake control rod and brake lever to make certain they are free and not binding. With a feeler gage, check the clearance between the heel and toe of both inner and outer brake shoes and the brake drum (fig. 116). If the clearance does not measure 0.010 inch, the brake shoes must be adjusted. Again check the clearance of the brake shoes and note readings at both heel and toe. If readings are not equal, place a piece of 0.010-inch shim stock between heel and toe of each brake shoe and brake drum. Loosen jam nut and turn anchor pin until heel of outer brake shoe just touches the shim stock. Remove cotter pin and clevis pin attaching adjusting yoke of brake control rod to brake lever. Loosen lock nut and turn adjusting yoke in or out to obtain correct clearance between toe of outer brake shoe and heel and toe of inner brake shoe. When brake shoes just touch the shim stock, the brake shoes are properly adjusted. Tighten jam nut and connect brake control rod to brake lever. Secure with clevis pin and cotter pin. Test operation of parking brake.

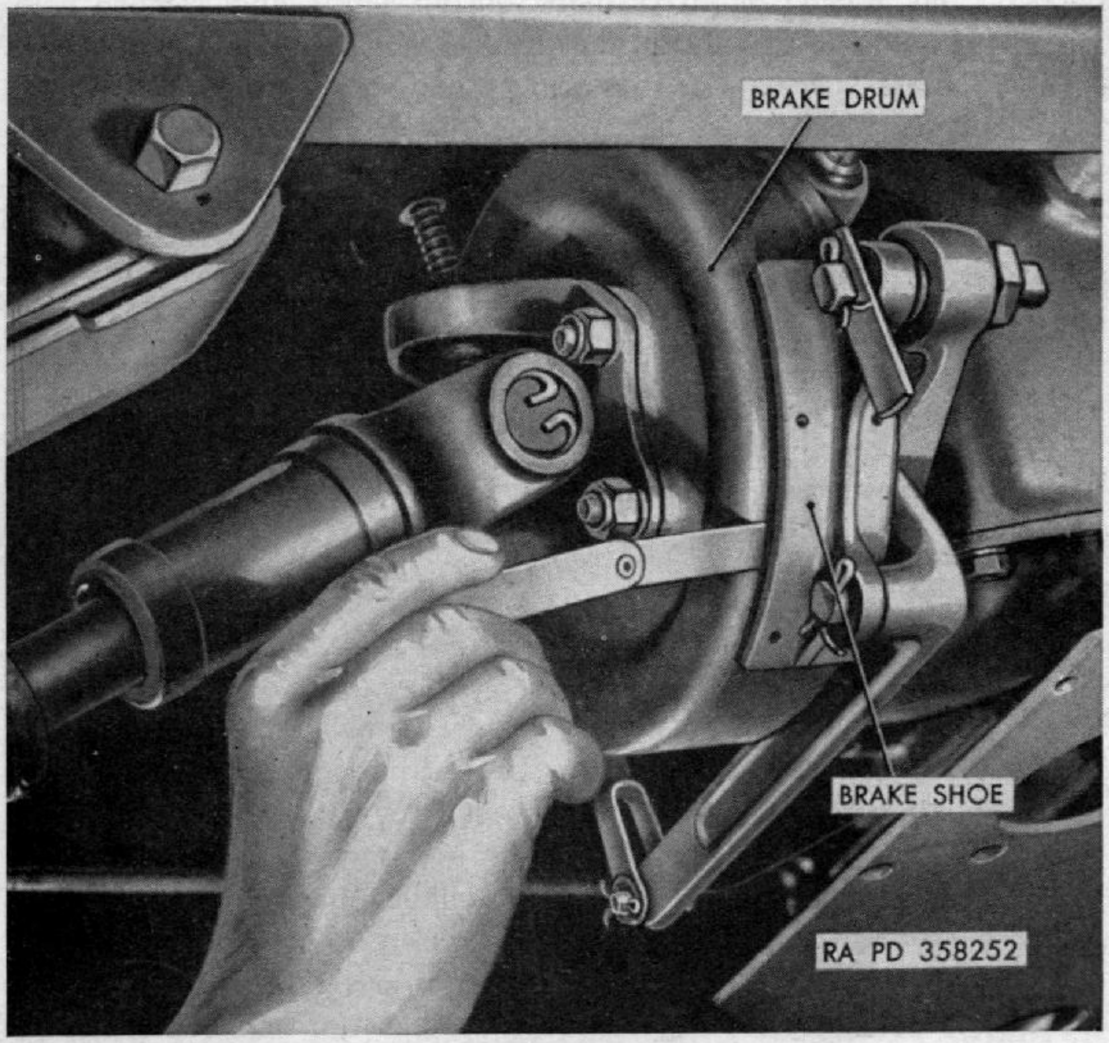


Figure 116. Checking brake shoe clearance.

b. Brake Shoes (fig. 115).

(1) *Removal.* Remove cotter pin and clevis pin securing adjusting yoke to brake lever and disconnect adjusting yoke from brake lever. Remove cotter pin and anchor pin stop from anchor pin. Remove brake lever with inner and outer brake shoes attached from brake drum. Remove two cotter pins and remove inner and outer brake shoes from brake lever.

(2) *Installation.* Position inner and outer brake shoes on brake lever and secure with cotter pin. Position brake lever and brake shoes on brake drum. Place upper end of outer brake shoe over anchor pin and secure with anchor pin stop and cotter pin. Connect adjusting yoke to brake lever and secure with clevis pin and cotter pin. Adjust parking brake (*a* above).

c. Brake Drum.

(1) *Removal.* Remove brake shoes (*b* above). Remove four safety nuts attaching universal joint flange (fig. 115) and lower propeller shaft to floor. Remove cotter pin, nut, and flat washer from transfer output shaft and remove companion flange and brake drum.

(2) *Installation.* Position brake drum and companion flange on transfer output shaft and secure with flat washer, and cotter pin. Lift propeller shaft with universal joint flange attached and position on brake drum, making sure that cap screws are installed through companion flange, brake drum, and universal joint flange. Install safety nuts on cap screws to secure these items. Install brake shoes (*b* above).

Section XXIV. SPRINGS AND SHOCK ABSORBERS

197. Description and Data

a. Description.

(1) *Springs.* Both front and rear springs (figs. 117 and 118) are of the semielliptic type with double wrapped eyes. Each spring assembly is equipped with four rebound clips which serve to hold the spring leaves in alinement and together to take the rebound forces. Both front and rear springs are mounted at the rear by **U** type spring shackles (figs. 117 and 118) and at the front by pivot bolts. The pivot bolt end of the spring is equipped with a rubber mounted bearing (fig. 120) to permit flexing at this point. The spring shackles have a small forged bar on the lower shank and the shackle bushings have a groove cut around the hexagon head for lubrication.

(2) *Shock Absorbers.* The shock absorbers (figs. 117 and 118) are the hydraulic cylinder, direct-acting, two-way control units mounted in rubber bushings. The shock absorbers are mounted to the frame and spring clip plate and serve to control the action of the springs when flexing. The shock absorbers are nonadjustable and nonrefillable.

b. Data.

Front springs:	
Length (center line of spring eyes)	$39\frac{1}{2}$ in
Width	$1\frac{3}{4}$
Number of leaves	9
Rear springs:	
Length (center line of spring eyes)	46 in
Width	$1\frac{3}{4}$ in
Number of leaves	11
Shock absorbers:	
Type	Monroe "W"—hydraulic
Action	two-way direct
Length compressed—front	$11\frac{7}{16}$ in
Length compressed—rear	$11\frac{15}{16}$ in
Length extended—front	$18\frac{7}{16}$ in
Length extended—front	$18\frac{7}{16}$ in

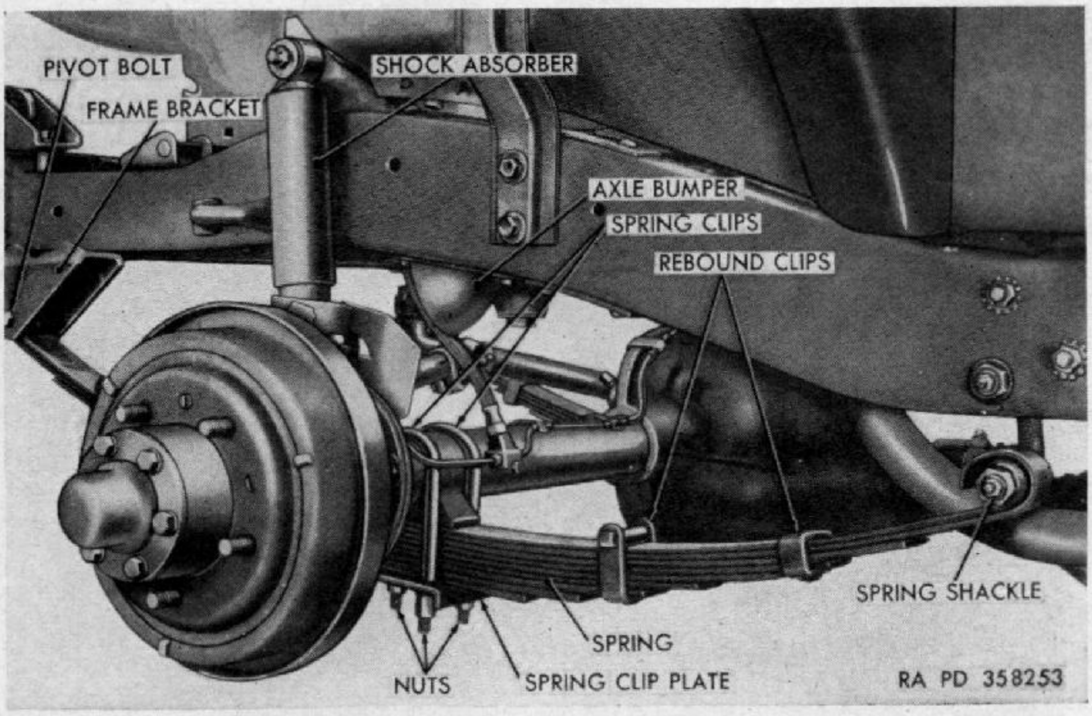


Figure 117. Front spring installed.

198. Maintenance

The springs and shock absorbers should be inspected periodically for wear or breakage. The spring shackles should be lubricated in accordance with the lubrication chart (par. 53). The pivot bolts

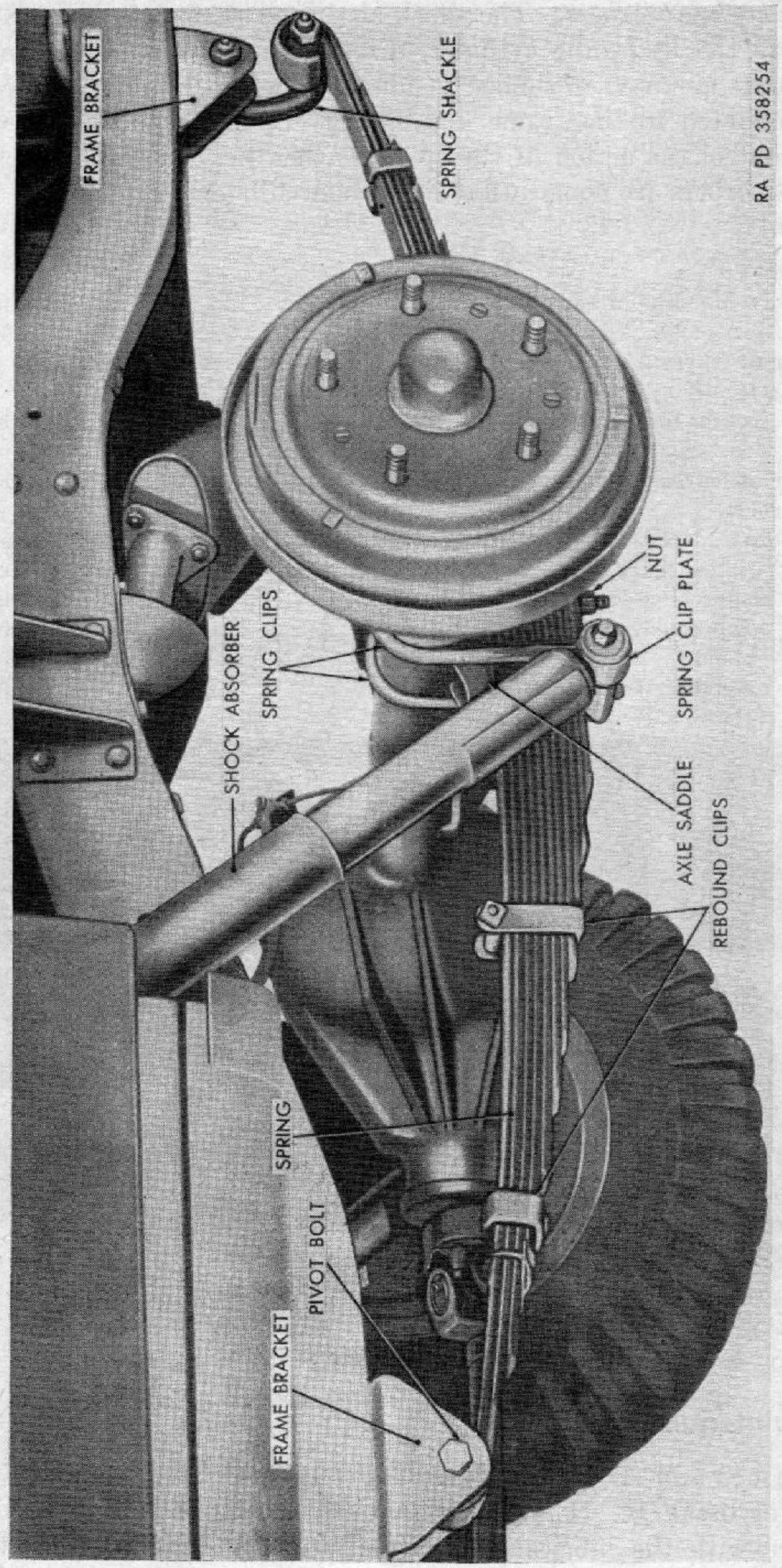


Figure 118. Rear spring installed.

require no lubrication. The shock absorbers require no attention except to replace the inoperative or damaged units and worn rubber bushings.

199. Spring Shackles

(fig. 119)

a. Removal. Raise vehicle sufficiently to take load off springs and place a jack under axle. Remove shackle bushings.

Note.—Left-hand threaded shackle bushings are used on left-front and right-rear springs.

Remove spring shackle with grease seals and grease seal retainer.

b. Installation. Install grease seal retainer and grease seal over threads of spring shackle and push up to shoulder of spring shackle. Insert the spring shackle through the frame bracket (rear) or frame (front) and the spring eye, giving careful attention to the proper threads. Hold spring shackle tightly against frame and start the upper shackle bushing and draw it up approximately halfway. Then start lower shackle bushing, holding spring shackle tightly against spring eye, and clean this shackle bushing up halfway. Alternately

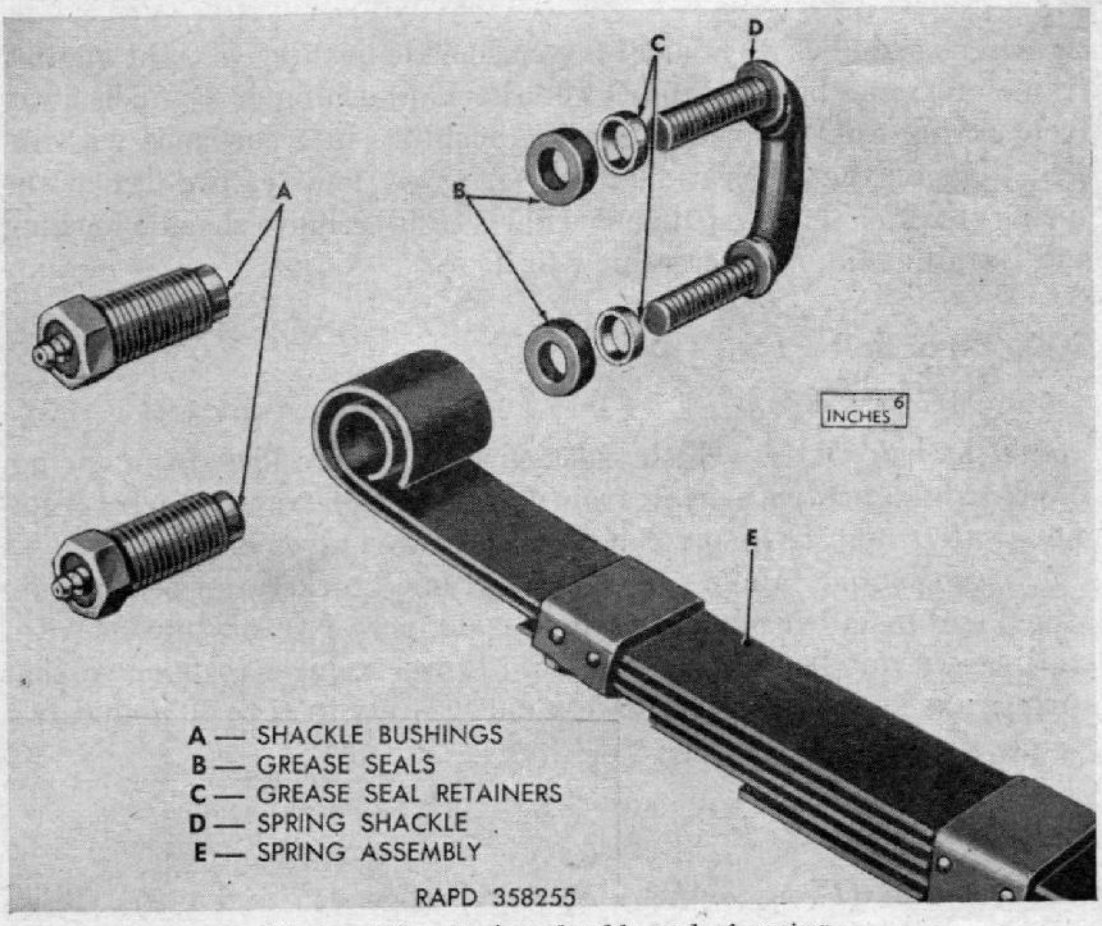


Figure 119. Spring shackle end of spring.

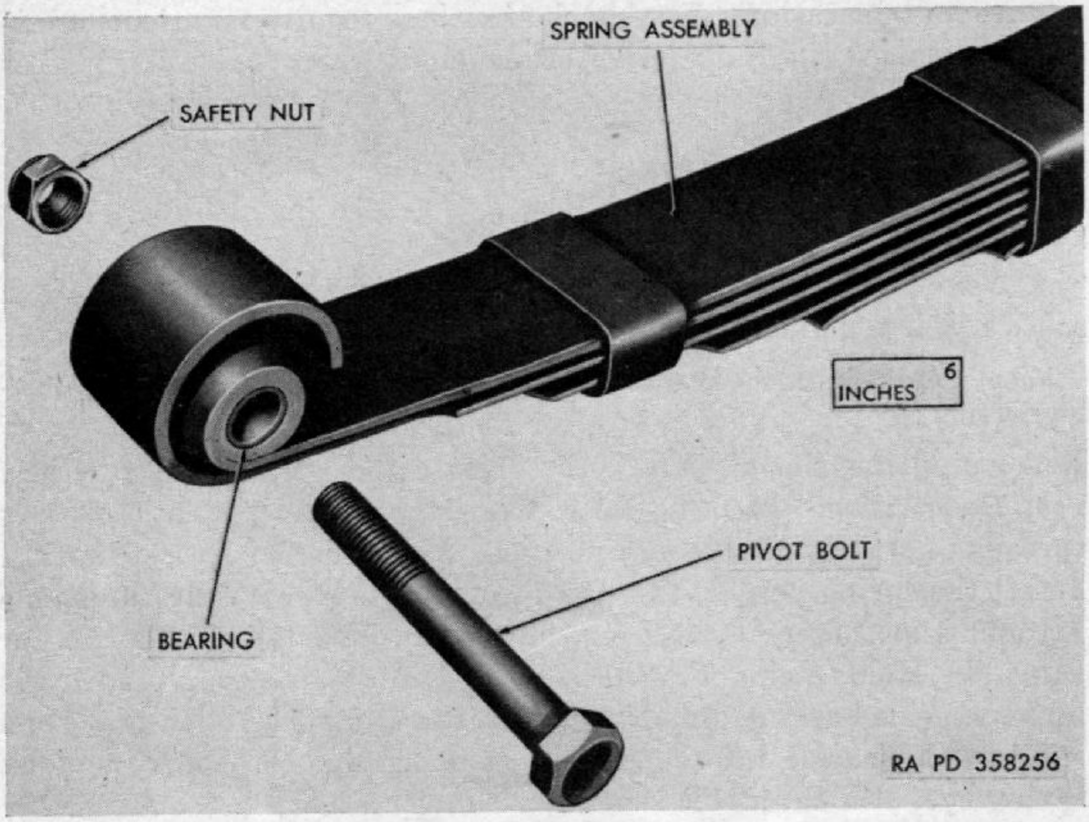


Figure 120. Pivot bolt end of spring.

tighten shackle bushings until upper shackle bushing is tight against frame or frame bracket and lower shackle bushing is $\frac{1}{32}$-inch away from spring eye. Lubricate shackle bushings in accordance with instructions on the lubrication chart (par. 53) and try the flex of the spring shackle. If the spring shackle is tight, remove shackle bushing and install again. Lower vehicle to floor.

200. Pivot Bolt
(fig. 120)

a. Removal. Raise vehicle sufficiently to relieve load from spring. Block axle to prevent spring from falling out of frame bracket. Remove safety nut from pivot bolt and remove pivot bolt.

b. Installation. Make sure hole in frame bracket and bearing are alined and install pivot bolt from outside face of frame bracket. Install safety nut but do not tighten. Lower vehicle to floor so that springs are loaded. Tighten safety nut securely to 27 to 30 pound-feet torque.

201. Springs

a. Removal (Front or Rear Springs) (figs. 117 and 118). Raise vehicle until load is released from springs. Block up axle to prevent it from falling. Remove spring shackle (par. 199) and pivot bolt (par. 200*a*). Remove four nuts and lock washers securing spring clip plate and spring to axle and disconnect lower end of shock absorber (par. 202). Remove spring clip plate and spring.

b. Installation (Front or Rear Springs) (figs. 117 and 118). Raise axle sufficiently to permit spring to be installed on pivot bolt and spring shackle without touching the axle. Raise spring into position and install spring shackle (par. 199*b*) and pivot bolt (par. 200*b*) but do not tighten safety nut. Slowly lower axle onto spring making certain spring center bolt enters recess in spring saddle on axle. Install spring clip plate, inserting spring clips down through holes in spring clip plate. Secure spring clip plate to spring clips with four nuts and lock washer. Connect shock absorber to spring clip plate (par. 202). Lower vehicle to floor and tighten safety nut on pivot bolt.

202. Shock Absorber
(fig. 121)

a. Removal. Remove safety nuts attaching shock absorber to frame and spring clip plate and remove both flat washers. Remove shock absorber and bushings from vehicle.

b. Installation. Install inner bushing on upper and lower shafts making certain tapered end of bushing is facing out. Install shock absorber and outer bushing on shafts and install flat washers. Install safety nuts and tighten until bushings show compression behind flat washers.

Section XXV. STEERING SYSTEM

203. Description and Data

a. Description.

(1) *General.* The steering system (fig. 122) consists of the steering gear, drag link, steering bellcrank, and tie rod assemblies. The steering system is of conventional design with all units interconnected to exert force either to the right or left by turning the steering wheel. As the Pitman arm attached to the steering gear swings in an arc, force is exerted laterally on the drag link either forward or back. This action pivots the bellcrank, thereby moving the tie rods and wheels to the right or left. Tie rods and steering bellcranks are covered in paragraphs 169 through 180.

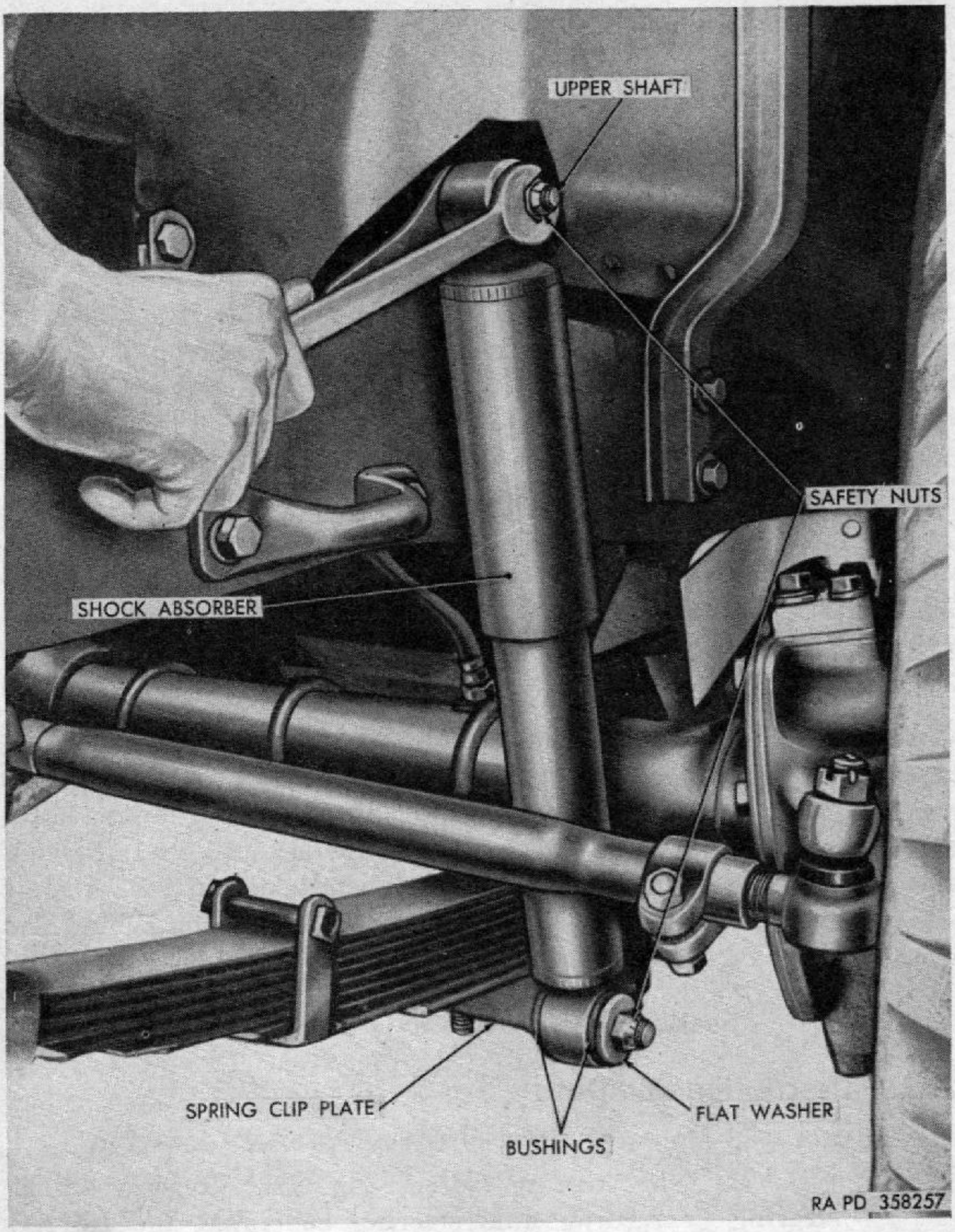


Figure 121. Removing shock absorber.

(2) *Drag link* (fig. 122). The drag link is of the adjustable ball and socket type and connects between the steering gear and the steering bellcrank.

(3) *Steering gear assembly* (fig. 122). The steering gear is of the cam and lever type with a variable ratio cam and is mounted on the left side of the vehicle. The steering wheel is of the three spoke, safety type incorporating a horn button.

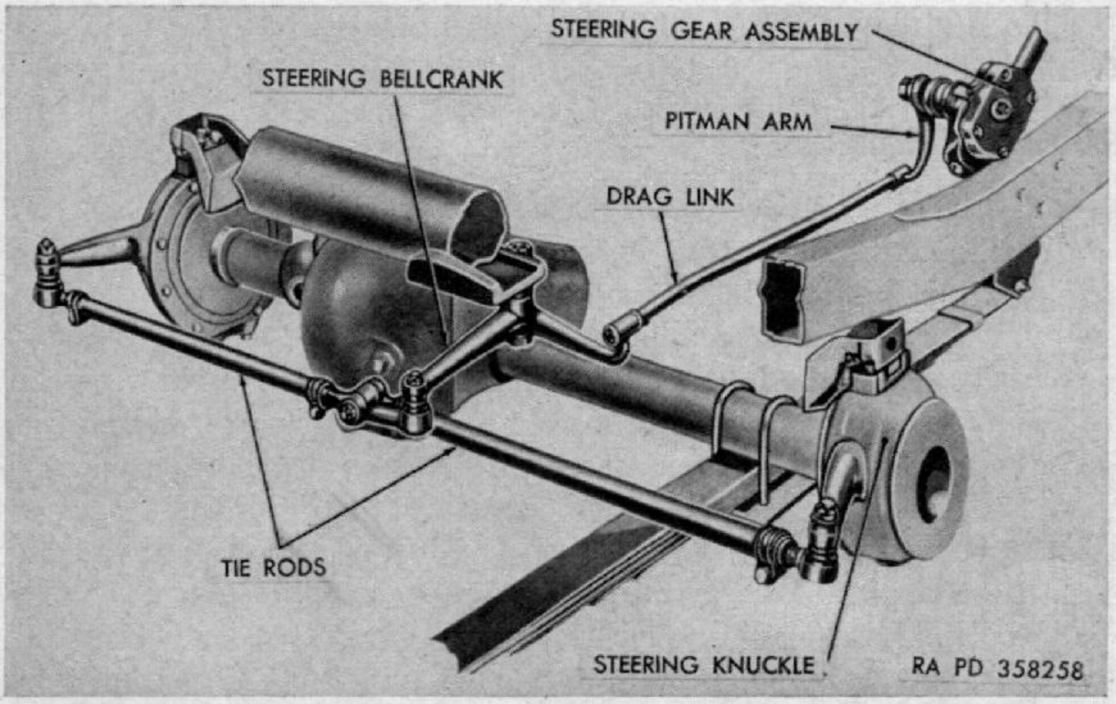


Figure 122. Steering system.

b. Data.

Manufacturer	Ross
Model	TL–130005
Type	cam and twin pin lever
Ratios:	
Extreme left	19.1
Center	17.1
Extreme right	19.1

204. Maintenance

a. Maintenance consists primarily of proper lubrication in accordance with instructions on the lubrication chart (par. 53). Periodic inspections must be made in accordance with preventive maintenance procedures (table II) to include the Pitman arm and drag link. A systematic inspection for steering troubles is as follows:

(1) Equalize tire pressures (par. 211) and set car on a level floor.
(2) Inspect kingpin and wheel bearings for looseness.
(3) Check wheel run-out by spinning wheel.
(4) Check for spring sag.
(5) Inspect brakes and shock absorbers.
(6) Check steering gear and drag link.
(7) Check toe-in (par. 171).
(8) Check tracking of front and rear axles.
(9) Check frame alinement.

b. If steering difficulty is experienced after checking and correcting the above items, report to ordnance maintenance personnel as the trouble is probably due to improper wheel balance, caster, camber, or kingpin inclination.

205. Drag Link

a. Removal. Remove cotter pin from adjusting plug at each end of drag link. Remove adjusting plug from each end of drag link and remove drag link and dust cover and dust cover shield.

b. Installation. Correct end of drag link to be attached to steering bellcrank so that the lubrication fitting will be to the right. Install ball seat spring plug, ball seat spring, and drag link ball seat in this end of drag link. Place end of drag link on steering bellcrank and install adjusting plug. Tighten adjusting plug up tight against steering bellcrank ball, back adjusting plug off one-half turn, and install cotter pin. Insert drag link ball seat in opposite end of drag link and install drag link on Pitman arm. Install second drag link ball seat, ball seat spring, ball seat spring plug, and adjusting plug. Tighten adjusting plug securely against ball seat spring plug and back off one-half turn. Lock with cotter pin. Lubricate drag link in accordance with instructions in paragraph 53.

206. Steering Wheel

a. Removal. Raise hood (par. 216) and disconnect cables at connectors on horn switch. Pry rubber cap from nut securing steering wheel. Lift off horn button. Remove nut securing steering wheel. With puller 41–P–2954, remove the steering wheel. Remove spring from steering column to avoid loss when steering wheel is being removed from complete steering gear (fig. 124) removal (par. 208).

b. Installation. Set front wheels in straightahead position. Install spring in steering column if removed. Position steering wheel on steering tube with one spoke of steering wheel in vertical position above steering column and line up serrations. Using a rubber mallet, tap steering wheel on steering tube. Install nut securing steering wheel and tighten securely. Place horn button on horn push rod and install rubber cap over nut.

207. Pitman Arm

a. Removal. Remove nut and flat washer from arm shaft. Remove Pitman arm (fig. 122) by driving a wedge type remover between Pitman arm and steering gear housing. If a remover is not available, use a chisel and drive between the Pitman arm and the steering gear housing. Then, using a bar, strike rear side of Pitman arm to loosen it on the tapered serrations on the arm shaft.

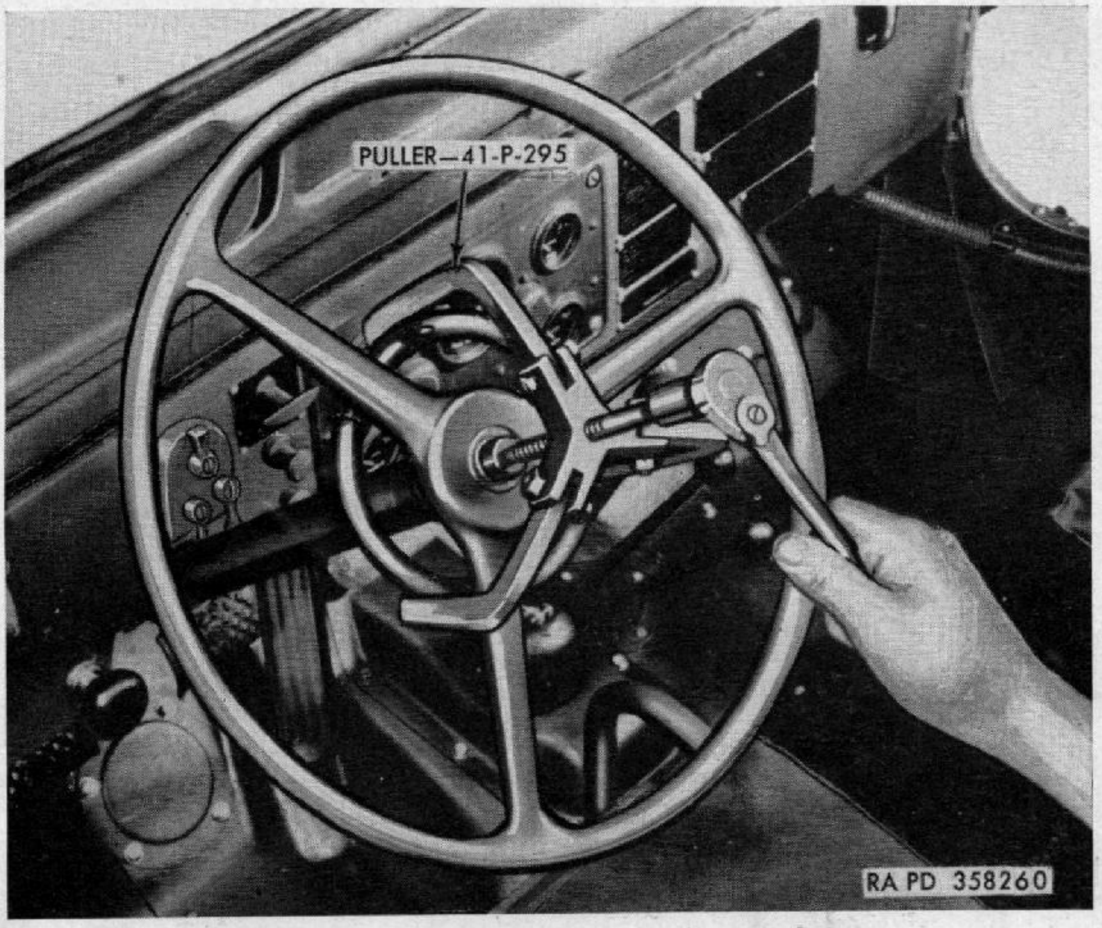


Figure 123. Removing steering wheel.

Caution.—Do not drive chisel or remove too deep as damage will result to serrations on arm shaft.
Disconnect drag link from the Pitman arm (par. 204*a*).

b. Installation. Turn steering wheel maximum distance to right; turn wheel to left, counting the turns on revolutions. Turn wheel back to right exactly one-half turns. This centers steering wheel. Install drag link on Pitman arm (par. 205*b*). Set wheels in straight-ahead position and install Pitman arm on arm shaft. Tap Pitman arm lightly with a rubber mallet to seat Pitman arm on arm shaft serrations. Install flat washer and nut to secure Pitman arm. Check and adjust toe-in (par. 171), if necessary. Lubricate drag link in accordance with instructions in paragraph 53.

208. Steering Gear
(fig. 124)

a. Adjustment. Turn steering wheel until wheels are in the straightahead position. Loosen adjusting screw jam nut. Turn adjusting screw in until it contacts the arm shaft. Tighten adjusting screw jam nut securely. To test the adjustment, place wheels in the straightahead position. Place a piece of tape on the top of the steering wheel and a piece of tape in direct line on the instrument panel. Turn steering wheel one-quarter turn to the right. Attach a spring scale to the spoke of the steering wheel as close to the outer rim as possible and pull steering wheel through center. The pounds pull required to pull steering wheel through center should be 3½ to 4 pounds. If the pull exceeds this figure, loosen adjusting screw jam nut and back off adjusting screw very slightly or until correct pounds pull is indicated.

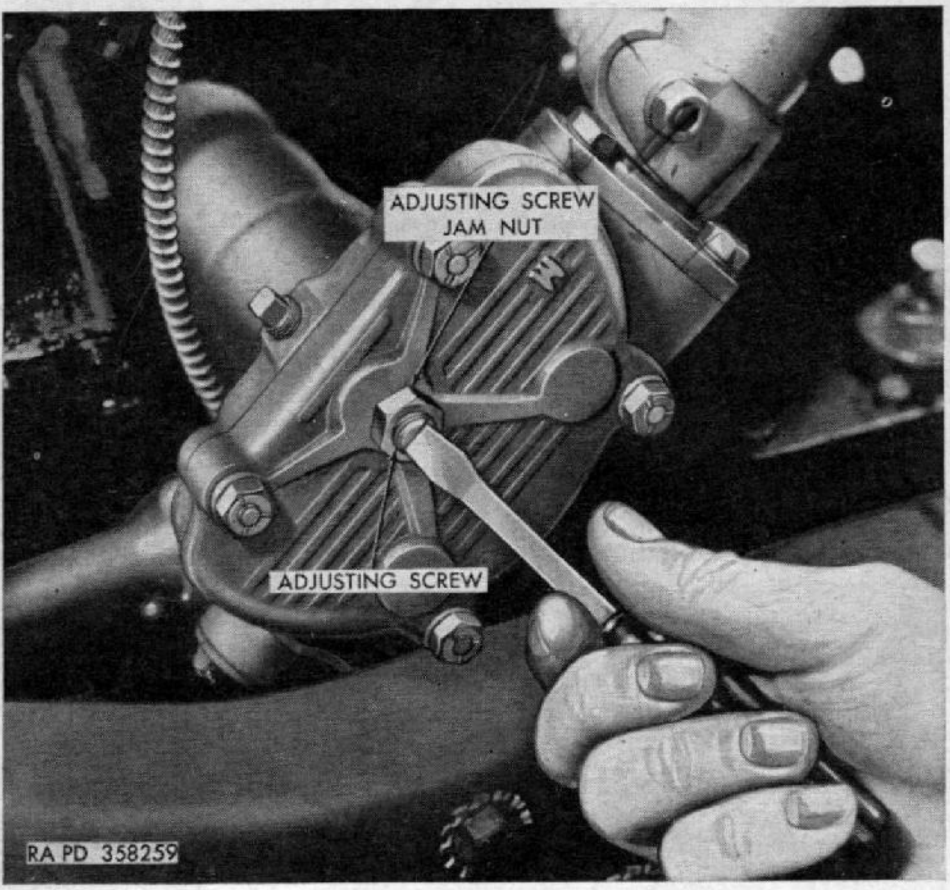


Figure 124. Steering gear adjustment.

b. Removal.

(1) Raise hood (par. 216). Disconnect the drag link from the Pitman arm (par. 205*a*). Disconnect cables at connectors on horn switch. Remove steering wheel (par. 206*a*).

(2) Remove four cap screws and lock washers attaching brake master cylinder inspection cover (K, fig. 37) to floor board. Reach through opening and disconnect vent line from brake master cylinder.

(3) Remove clutch and brake pedal pads. Remove four cap screws and lock washers securing retainer ring (B, fig. 37) and grommet around steering column; separate retainer ring and remove. Remove three cap screws and lock washers

securing floor board extension (C, fig. 37) to floor board and remove.

(4) Disconnect accelerator pedal control rod (fig. 49) at lower bellcrank and pull accelerator pedal and accelerator control rod back through floor board.

(5) Remove 10 cap screws and lock washers securing upper floor board and remove upper floor board. Remove two cap screws and lock washers attaching steering column bracket and remove steering column bracket.

(6) Have an assistant support the steering gear from the passenger compartment and remove three bolts attaching steering gear to frame. Depress both brake and clutch pedal as far as possible and pull steering gear out from passenger compartment side of vehicle.

Note.—Some manipulation may be necessary to clear protrusion on steering gear housing and Pitman arm.

c. Installation.

(1) From passenger compartment, install steering gear through opening in floor board.

Note.—Some manipulation may be necessary to clear protrusion on steering gear housing and Pitman arm. Depressing of both clutch and brake pedals will aid in installation.

While a helper supports the steering gear from the passenger compartment, install three bolts securing steering gear to frame. Do not tighten bolts.

(2) Install steering column bracket and secure with two cap screws and lock washers. Do not tighten cap screws.

(3) Install upper floor pan and secure with 10 cap screws and lock washers.

Note.—Do not install cap screws in holes where floor board extension or brake master cylinder inspection cover (K, fig. 37) fit.

Push accelerator control rod through floor board and connect to lower bellcrank and adjust (par. 103).

(4) Connect vent line to brake master cylinder, install brake master cylinder inspection cover and secure with four cap screws and lock washers. Install floor board extension (C, fig. 37) and secure with three cap screws and lock washers. Position grommet and retainer ring (B, fig. 37) around steering column and secure with four cap screws and lock washers. Center steering gear in grommet and tighten three bolts attaching steering gear to frame.

(5) Tighten two cap screws securing steering column bracket. Connect cables to connectors on horn switch.

(6) *Install steering wheel* (par. 206*b*). Connect drag link to Pitman arm (par. 205*b*). Install pads on brake and clutch pedals. Check and, if necessary, adjust toe-in (par. 171).

Section XXVI. WHEELS AND TIRES

209. Description and Data

a. Description.

(1) *Wheels.* Four conventional type, interchangeable wheels are used. Each wheel is secured to the wheel hub by five stud nuts. The studs are pressed into the wheel hub. The wheels do not pilot on the wheel hub; taper on stud nuts engage chamfered holes in wheel, positioning wheel concentric with wheel hub. This permits clearance between the wheel base and the wheel hub for easier removal and installation of wheels. Wheel studs and stud nuts on left side of vehicle all have left-hand threads.

(2) *Tires.* All four wheels are equipped with standard military type pneumatic tires. These tires are designed for either high or low pressure operation.

b. Data.

Wheels:	
Ordnance number	7387807
Rim size	16–4.50 in
Stud circle diameter	5.496 to 5.504 in
Tires:	
Type	standard military
Size	7.00 x 16
Operating pressures:	
Highway	28 psi
Cross-country	22 psi
Mud, sand, or snow	15 psi

210. Wheels

a. Removal. Loosen five stud nuts, turn stud nuts on right side of vehicle counterclockwise and turn stud nuts on left side of vehicle clockwise. Jack vehicle up until tire clears floor and block other wheels to prevent vehicle from rolling. Remove the five stud nuts and left wheel and tire off wheel hub.

b. Installation. Make sure mating surfaces of wheel and wheel hub are clean and that studs are free of grease and oil. Position wheel on wheel hub and install five stud nuts. Tighten stud nuts alternately. Lower vehicle to floor and remove blocks from other wheels. Again tighten stud nuts.

211. Tires and Tubes

a. Gaging and Inflating Tires.

(1) Before tires are inflated to correct pressure, each tire should be gaged for pressure loss. If any appreciable loss of air is noticed in a tire, that tire should be dismounted and examined for cause of pressure loss. When making a pressure loss check, use the same inflation gage on all tires so that any element of inaccuracy in the gage will be the same for all tires.

Note.—Take tire pressure reading when tires are cold; do not reduce the pressure of overinflated hot tires.

(2) Tires should be inflated to 28 psi for highway (hard-surfaced roads) operation, 22 psi for cross-country operation, and 15 psi for operation in mud, snow, or sand. Pressure in all tires must be equal, unequal pressures will affect braking and steering. After inflation and checking of tires, always replace the valve cap to prevent loss of air or damage to valve core.

b. Matching and Rotating Tires. Replacement tires should be of the same design, size, and tread as the other tires on the vehicle. Differences in design and tread in some instances result in unequal rolling

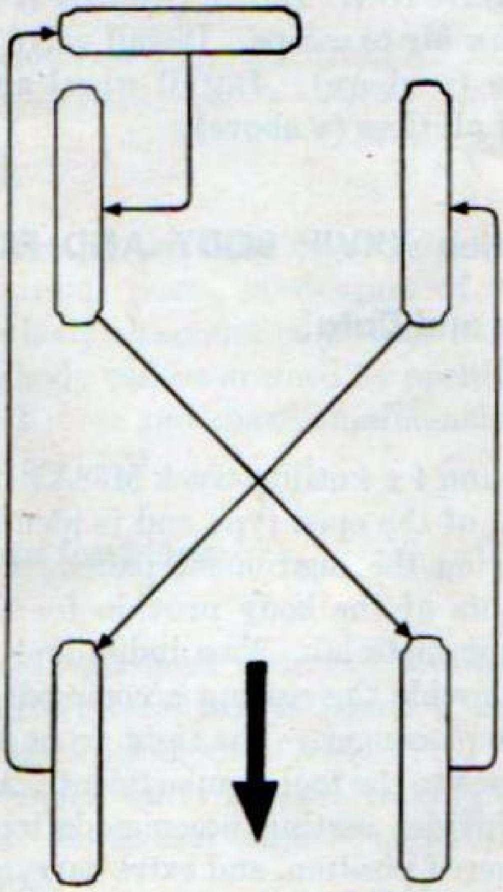


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Figure 125. Tire rotation plan.

diameter within one-eighth of an inch, excessive scuffing will result. To maintain equal wear of tires, tires should be rotated at approximately 2,000-mile intervals if the tactical situation permits. Refer to tire rotation plan (fig. 125) for correct rotation of tires.

c. Tire and Tube Removal. Jack up vehicle and remove wheel and tire (par. 210*a*). Remove valve core to completely deflate tube. Using conventional tire removal tools, dislodge bead of tire from the rim of the wheel on both sides. Push valve stem down into hole in wheel rim. Using a tire tool, pry edge of tire up over the edge of the wheel rim completely around the wheel. Spread tire away from edge of wheel and remove tube. Remove opposite bead from wheel rim to separate wheel from tire.

Caution.—When removing tire, exercise care not to pinch tube against wheel with tire tool.

d. Tire and Tube Installation.—Place wheel on floor with hole for valve stem facing up. Place inner bead of tire over outer edge of wheel and, using a rubber mallet, rap tire bead over rim of wheel. Install valve core in valve stem and inflate tube slightly to hold it in tire. Position tube in tire with valve stem up through hole in wheel. Rap outer edge of tire over wheel rim taking care not to pinch tube between tire and wheel. Move wheel in tire to properly center valve stem and remove valve core. Inflate tire to seat bead of tire against wheel rim and allow air to escape. Install valve core and inflate tire to proper pressure (*a* above). Install wheel and tire (par. 210*b*). Check pressures of all tires (*a* above).

Section XXVII. BODY AND FRAME

212. Description and Data

a. Description.

(1) *Body.*

(*a*) The 1/4-ton 4 x 4 utility truck M38A1 (figs. 1 and 2) body is all steel of the open type and is identified by name plates (fig. 4) on the instrument panel. Front and rear compartments of the body provide for the carrying of personnel or material. Two individual tubular seats in the front provide the seating accommodations for the driver and one passenger. The right front seat is hinged to permit access to the tool compartment. A single, folding rear seat provides seating accommodations for two when in the lowered position, and extra carrying space on the floor when in the raised position.

(b) Weather protection is provided by the folding windshield (fig. 126) and a canvas top (fig. 126). The body is equipped with an outside rear vision mirror mounted on the left side of the vehicle and dual vacuum windshield wipers at the top of the windshield. Provisions are made on the body for the mounting of a machine gun mount, rifle holders, side curtains and doors, and a metal top inclosure. The outside of the body features a spare fuel can carrier and spare wheel carrier at the rear and footman loops for the stowage of other items.

(2) *Frame.* The frame is of the box steel type with five cross members to provide strength. Extension and brackets provide mounts for the engine and body. Bumpers at the front and rear provide for protection against damage. A pintle hook (fig. 11) is mounted at the rear of the frame to provide means of hauling a trailed load.

b. Data.

Body type	all steel, open
Driver's position	left
Windshield type	two piece, folding
Frame length	128.44 in
Frame width	29.25 in
Number of frame crossmember	5
Frame type	all-steel-box

213. Maintenance

General maintenance of the body requires periodic tightening of all loose body and frame parts, lubrication of wearing parts, and cleaning. Keep the body clean and paint bare metal spots to prevent rust. Water in the body can be drained by opening the drain covers in the floor board. Frame and chassis maintenance concerns mainly proper lubrication (par. 53).

214. Seats and Seat Cushions

a. Removal.

(1) *Driver's seat.* Remove four cap screws and lock washers attaching driver's seat to floor board, wheel housing, and side pawl; lift seat up and out of body.

(2) *Front passenger seat.* Remove locking pins from holes in each hinge. Raise seat slightly and slide seat out of slots in each hinge.

(3) *Rear seat.* Remove two cap screws and lock washers securing each back hook to body and remove seat back hooks. Fold

seat up and remove cap screw and lock washer securing a hold down clip to each side of body. Lift seat out of seat bracket and body.

b. Installation.

(1) *Driver's seat.* Position driver's seat in body and line up cap screw holes. Install four cap screws and lock washers to secure driver's seat to body.

(2) *Front passenger seat.* Position seat in body, line pins on seat frame up with slots in seat hinge, and install seat in hinge. Secure seat by installing locking pins in holes in each hinge.

(3) *Rear seat.* Position rear seat in body so that ends of seat frame fit brackets. Place hold-down clip over seat frame and seat bracket; secure with cap screw and lock washer in each.

c. Removal of Seat Cushions and Seat Backs.

(1) *Front seats.* Remove driver's seat (*a* above) or fold front passenger seat forward. Remove cap screws and lock washers securing seat cushion to seat frame. Slide seat cushion forward to disengage clips at rear and remove seat cushion. Remove 12 screws and washers attaching edge of seat back to tubular edge of seat frame and remove seat back.

(2) *Rear seat.* Remove five screws and washers securing front edge of seat cushion to seat frame. Remove five screws and washers securing rear edge of seat cushion. Remove five screws and washers securing top edge and five screws and washers securing bottom edge of seat back to seat frame and remove seat back.

d. Installation of Seat Cushions and Seat Backs.

(1) *Front seats.* Position seat cushion and seat frame making sure clips on seat cushion go under rear edge of seat frame. Install two cap screws and lock washers to secure seat cushion to seat frame. Install driver's seat (*b* above) or let front passenger seat down. Position seat back on seat frame and install four screws and washers along top edge. Install remaining eight screws and washers.

(2) *Rear seat.* Place seat cushion in position on seat frame and install five screws and washers securing rear edge to seat frame. Pull seat cushion forward and install five screws and washers securing front of seat cushion. Place seat back in position and install five screws and washers securing lower edge to seat frame. Pull seat cushion up and install five screws and washers securing top edge of seat cushion.

215. Windshield

a. Lowering and Raising. To lower windshield, unhook windshield clamps (C, fig. 6) at each side of windshield. Carefully lower windshield forward until brackets on the top windshield contact hood. Secure windshield in lowered position by hooking strap on windshield to loop on hood. To raise windshield, unfasten strap securing windshield to hood and raise windshield up to upright position. Hook windshield clamps.

b. Removal. Pull windshield wiper vacuum hose from windshield wiper vacuum line. Unhook windshield clamps (C, fig. 6) on each side of windshield. Fold windshield forward until slot in hinges on windshield lines up with flat face of pin in hinge on body, slip windshield off pins, and remove from body.

c. Installation. Position windshield above hinges and line up slots in hinges on windshield with flat faces of pin in hinges on body and install windshield on body. Fold windshield back in the upright position and hook windshield clamps. Connect windshield wiper vacuum hose to windshield wiper vacuum line.

216. Hood

a. Raising and Lowering. To raise hood, unhook hood latches at either side of hood. Lift hood up and engage loop on hood with latch on upper part of windshield. To lower hood, release latch and carefully lower hood. Hook hood latches.

b. Removal. Unhook hood latches on both sides of the hood. Raise hood until slots in hinge on hood line up with flat face of pins in hinge on body, move hood forward and remove from vehicle.

c. Installation. Position hood on vehicle by lining up the slots in the hinge on hood with the flat faces of the pin on the hinge on the body. Loosen hood and secure with hood latches.

217. Radiator Grille

a. Removal. Removal of the radiator grille is outlined in paragraph 96*b*.

b. Installation. Installation of the radiator grille is outlined in paragraph 97.

218. Canvas Top

(fig. 126)

Note.—No illustrations have been provided in this manual as to the proper method of folding and storage of the canvas top. Extreme caution must be taken to prevent unnecessary damage to the vinalyte position of the canvas top.

a. Installation. Remove the two wing screws at the pivot brackets on both sides of the body. Slide tubular top bows back and out of brackets. Install flat ends of top bows in the brackets near rear of body, making sure top bow fits down in bracket all the way. Allow front top bow to drop down over front seats. Insert head of front edge of canvas top in groove at top of windshield and, working from right to left, pull edge through groove until there is an equal distance at both sides installed. Stretch canvas top over top bow and down to body rear panel. Place the six top straps in the loops on the body and buckle straps. Raise front portion of top bow up and install metal rods in holes in front portion of top bow and windshield. Secure rods with locking pins. Snap three top flaps on front top bow. Snap top side flaps around metal rods. Install wing screws in rear brackets.

b. Removal. Unsnap three top flaps on front top bow and along side flaps. Remove locking pins and remove rods from front section of top bow and windshield. Drop front top bow over front seats. Unfasten six straps at rear attaching canvas top to rear panel of body.

Figure 126. Canvas top installed.

Lift canvas top up and over the top bow. Grasp right outside edge of canvas top and pull canvas top bead out of groove at top of windshield. Remove wing screws from rear brackets and lift top bows up out of rear brackets. Lay top bows along top edge around body and insert top bows in front bracket. Install wing screws in front bracket.

219. Fenders

Note.—If both the right and left front fenders are to be removed at the same time, start the operation by removing the grille (par. 96*b*). If only one of the fenders is to be removed proceed as in *a* below.

a. Removal.

(1) *Right front fender.* Raise hood (par. 216). Unclip battery ground cable and outlet cable, if installed, from the rear portion of the fender. Remove three cap screws, lock washers, and flat washers attaching fender to grille. Remove two cap screws, lock washers, and flat washers attaching fender brace to frame. Remove four cap screws and flat washers securing fender to body, pull fender out away from vehicle, and remove.

(2) *Left front fender.* Raise hood (par. 216). Remove battery ground cable from battery terminal (par. 127*e*). Remove blackout light (par. 129) and horn (par. 133). Disconnect headlight and blackout marker light cables at the headlight and blackout marker cable connectors (fig. 34). Remove cable clips attaching blackout driving light cable, horn cable, and headlight and blackout marker light cable to fender. Remove three cap screws, lock washers, and flat washers attaching fender to grille. Remove two cap screws, lock washers, and flat washers attaching fender brace to frame. Remove four cap screws and flat washers attaching fender to body, pull fender out away from vehicle, and remove.

b. Installation.

(1) *Right front fender.* Position fender on vehicle and install one fender brace to frame cap screw with a lock washer and flat washer. Install one fender to body cap screw at top of fender with a flat washer. Install one cap screw attaching fender to grille with a flat washer and lock washer. Line fender up with body and grille and install remaining cap screw with lock washers and flat washers in body, frame, and grille. Install battery ground cable and outlet cable on fender with clips and secure clips with screws. Lower hood (par. 216).

(2) *Left front fender.* Position fender on vehicle and install one fender brace to frame cap screw with a flat washer and

lock washer. Install one fender to body cap screw at top of fender with a flat washer. Install one fender to grille cap screw with a flat washer and lock washer. Line fender up with body and grille and install remaining cap screws with lock washers and flat washers in body, frame, and grille. Install headlight and blackout marker light cable, blackout driving light cable, and horn cable in clips and secure clips to fender with screws. Install horn (par. 133) and blackout driving light (par. 129). Connect headlight and blackout marker light cables to the headlight and blackout marker light cable connectors (fig. 34). Connect battery ground cable to battery (par. 127*e*). Lower hood (par. 216).

220. Windshield Wiper

a. Removal. Pull hose from vacuum fitting on windshield wiper. Remove cap screw attaching windshield wiper arm to windshield wiper and remove windshield wiper arm. Remove two screws and lock washers securing windshield wiper to top of windshield and remove windshield wiper from inside of windshield.

b. Installation. Insert shaft of windshield wiper through hole at top of windshield and secure with two screws and lock washers installed from the outside. Position windshield wiper arm on windshield wiper shaft, parallel to hand lever on inside, and secure with cap screw. Connect hose to vacuum fitting on windshield wiper.

Section XXVIII. MAINTENANCE UNDER UNUSUAL CONDITIONS

221. Extreme-Cold Weather Maintenance Problems

a. The importance of maintenance must be impressed on all concerned, with special emphasis on organizational (preventive) maintenance. Maintenance of mechanical equipment in extreme cold is exceptionally difficult in the field. Even ship maintenance cannot be completed with normal speed, because the equipment must be allowed to thaw out and warm up before the mechanic can make satisfactory repairs. In the field, maintenance must be undertaken under the most difficult of conditions. Bare hands stick to cold metal. Fuel in contact with the hands results in supercooling due to evaporation, and the hands can be painfully frozen in the matter of minutes. Engine oils, except sub-zero grade, are unpourable at temperatures below −40° F. Ordinary greases become as solid as cold butter.

b. These difficulties increase the time required to perform maintenance. At temperature below −40° F, maintenance requires up to five times the normal amount of time. The time required to warm up a vehicle so that it is operable at temperatures as low as $-50°$ F, may approach 2 hours. Vehicles in poor mechanical conditions probably will not start at all, or only after many hours of laborious maintenance and heating. Complete winterization, diligent maintenance, and well-trained crews are the key to efficient arctic-winter operations.

c. Refer to TM 9–2855 and TB ORD 193 for general information on extreme-cold weather maintenance procedures.

d. Refer to pertinent technical bulletin for information on winterization kit for this vehicle.

222. Extreme-Cold Weather Maintenance

Refer to TM 9–2855 for a general discussion of maintenance problems, the application of antifreeze compounds and arctic type lubrication, handling of storage batteries in extreme cold, and dewinterization procedure.

223. Extreme-Hot Weather Maintenance

a. Cooling System. Thoroughly clean and flush cooling system (par. 121) at frequent intervals and keep system filled to within three-quarters of an inch of the overflow pipe with clean water when operating in extremely high temperatures. Formation of scale and rust in the cooling system occurs more rapidly during operation in extremely high temperatures; therefore, corrosion-inhibitor compound should always be added to the cooling liquid. Avoid the use of water that contains alkali or other substances which may cause scale and rust formation. Use soft water whenever possible.

b. Batteries.

(1) *Electrolyte level.* In torrid zones, check level of electrolyte in cells daily and replenish, if necessary, with pure distilled water. If this is not available, rain or drinking water may be used. However, continuous use of water with high mineral content will eventually cause damage to batteries and should be avoided.

(2) *Specific gravity.* Batteries operating in torrid climates should have a weaker electrolyte than for temperate climates. Instead of 1.280 specific gravity as issued, the electrolyte (sulphuric acid, spgr 1.280 should be diluted to 1.200 to 1.240 specific gravity (TM 9–2857). This is the correct reading for fully charged batteries. This procedure will prolong the life of the negative plates and separators. Batteries should be recharged at about 1.160 specific gravity.

(3) *Self-discharge.* A battery will self-discharge at a greater rate if left standing for long periods at high temperatures. This must be considered when operating in torrid zones. If necessary to park for several days, remove the battery and store in a cool place.

Note.—Do not store acid-type storage batteries near stacks or tires, as the acid fumes have a harmful effect on rubber.

c. Chassis and Body.

(1) In hot, dry climates, a careful watch must be kept for evidence of the moths and termites.

(2) In hot, damp climates, corrosive action will occur on all parts of the vehicle and will be accelerated during the rainy season. Evidences will appear in the form of rust and paint blisters on metal surfaces and mildew, mold, or fungus growth on wood, fabrics, leather, and glass.

(3) Protect all exposed exterior painted surfaces from corrosion by touch-up painting and keep a film of engine lubricating oil (OE–10) on unfinished exposed metal surfaces. Cables and terminals should be protected by ignition-insulation compound.

(4) Make frequent inspections of idle, inactive vehicles. Remove corrosion from exterior metal surfaces with abrasive paper or cloth and apply a protective coating of paint, oil, or suitable rust preventive.

224. Maintenance After Fording

a. General. Although the vehicle unit housings are sealed to prevent the free flow of water into the housings, it must be realized that, due to the necesssary design of these assemblies, some water may enter, especially during submersion. The following services should be accomplished on all vehicles which have been exposed to some depth of water or completedy submerged, especially in salt water. Precautions should be taken as soon as practicable to halt deterioration and avoid damage before the vehicle is driven extensively in regular service.

b. Body and Chassis. Drain and clean out body, engine, and tool compartment; clean all exposed painted surfaces and touch-up paint where necessary. Coat unpainted metal parts with engine lubricating oil (OE–10). Lubricate the chassis thoroughly as directed in the lubrication chart (par. 53). Do more than the usual lubrication job, making sure the lubricant is forced into each lubrication point to force out any water present.

c. Engine, Transmission, Transfer, and Axles. Check the lubricant in the engine, transmission, transfer, and axles. Should there be evidence that water has entered, drain, flush, and refill with correct lubricant. Remove and clean the engine oil filter (par. 90).

d. Wheels and Brakes. Remove the front wheels and flush out the steering knuckle housings with a half-and-half mixture of engine lubricating oil (OE–10) and dry-cleaning solvent or volatile mineral spirits. Refill the filler plug level with the correct lubricant (par. 53). Remove rear wheels. Work all wheel bearings thoroughly with dry-cleaning solvent or volatile mineral spirits, after which repack, assemble, and adjust. While the wheels are removed, dry out brake linings and clean rust and scum from brake drum face. Check brake system for presence of water.

e. Batteries. Check the batteries for quantity and specific gravity of electrolyte (par. 127*b*) to be sure no matter has entered through the vent caps. This is of special importance should the vehicle have been submerged in salt water.

f. Steering Gear. Remove and disassemble steering gear. If the lubricant is contaminated, clean the housing thoroughly with a half-and-half mixture of oil (OE–10) and dry-cleaning solvent or volatile mineral spirits. Assemble, refill with correct grade of lubricant, and adjust (par. 208*a*).

g. Electrical Connections. Check all electrical connections for corrosion, particularily the bayonet type connectors.

h. Fuel System. Drain fuel tank of any accumulated water, clean fuel filter and fuel lines, as necessary. If water is found in the carburetor air cleaner, clean and refill with oil (par. 107).

i. Distributor and Ignition Coil Assembly. Remove the distributor cap and check to determine if any water has entered the distributor and ignition coil assembly. If water is present, drain, clean, and lubricate the distributor cam as required (par. 53).

j. Condensation. Although most units are sealed, the sudden cooling of the warm interior air upon submersion may cause condensation of moisture within the cores or instruments. A period of exposure to warm air after fording should eliminate this fault. Cases which can be opened may be uncovered and dried.

k. Aluminum or Magnesium Parts. If vehicle remains in salt water for any appreciable length of time, aluminum or magnesium parts which were exposed to the water will probably be unfit for further use and must be replaced.

l. Deep-Water Fording. Refer to TM 9–2853 for deep-water fording information.

225. Maintenance After Operation on Unusual Terrain

a. Mud. Thorough cleaning and lubrication of all parts affected must be accomplished as soon as possible after operation in mud, particularly when a sea of liquid mud has been traversed. Clean radiator fins and interior of engine compartment. Replace wheel bearings if necessary. Clean, oil, and stow tire chains in vehicle.

b. Sand or Dust. Clean engine and engine compartment. Touch up all painted surfaces damaged by sandblasting. Lubricate completely to force out lubricant contaminated by sand or dust. Air cleaners and oil filters must be cleaned at least daily. Radiator fins should be cleaned daily with compressed air when operating in dusty terrain. Engine and other exposed vents should be covered with cloth at all times. When halted, grilles should be covered to protect the engine against entrance of sand or dust.

CHAPTER 4

SHIPMENT AND LIMITED STORAGE AND DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

226. Domestic Shipping Instructions

a. Preparation for Shipment in Zone of Interior. When shipping the 1/4-ton 4 x 4 utility truck M38A1 interstate or within the zone of interior, the officer in charge of preparing the shipment *will be responsible* for furnishing vehicles to the carriers for transport in a *serviceable* condition, properly cleaned, preserved, painted, and lubricated as prescribed in SB 9–4.

Note.—For loading and blocking instructions for these vehicles on flatcars, refer to paragraphs 228 and 229.

b. Removal of Preservatives for Shipment. Personnel withdrawing vehicles from a limited storage status for domestic shipment *must not remove preservatives* other than to insure that they are complete and serviceable. If it has been determined that preservatives have been removed, they must be restored prior to domestic shipment. Removal of preservatives is the responsibility of depots, ports, or field installations (posts, camps, and stations) receiving the shipments.

c. Preparation for Shipment to Ports (see AR 747–30).

(1) *Inspection.* All used vehicles destined for oversea use will be inspected prior to shipment in accordance with TB ORD 385.

(2) *Processing for shipment to ports.* All vehicles destined to ports of embarkation for oversea shipment will be further processed in accordance with SB 9–4.

Note.—Ports of embarkation will supplement any necessary or previously omitted processing upon receipt of vehicles in accordance with AR 747–30.

d. Army Shipping Documents. Prepare all Army shipping documents accompanying freight in accordance with TM 38–705.

e. Deep-Water Fording. If during the course of shipment operations embrace deep-water fording, prepare vehicles in accordance with TM 9–2853.

227. Limited Storage Instructions

a. General.

(1) The ¼-ton 4 x 4 utility truck M38A1 received for storage already processed for domestic shipment, as indicated on the Vehicle Processing Record Tag (DA AGO Form 9–3), must not be processed unless inspection performed on receipt of vehicles reveals corrosion, deterioration, etc.

(2) Completely process vehicles upon receipt directly from manufacturing facilities or if processing data recorded on the tag indicates that they have been rendered ineffective by operation or freight shipping damage.

(3) Vehicles to be prepared for limited storage must be given a limited technical inspection and be processed as prescribed in SB 9–63. Results and classification of vehicles will be entered on DA Form 461–5.

b. Receiving Inspections.

(1) Report of vehicles received for storage in a damaged condition or improperly prepared for shipment will be reported on DD Form 6 in accordance with SR 745–45–5. Report of vehicles received in an unsatisfactory condition (chronic failure or mulfunction of vehicle or equipment) will be reported on DA Form 468 in accordance with SR 700–45–5.

(2) When vehicles are inactivated, they are to be stored in a limited storage status for periods not to exceed 90 days. Stand-by storage for periods in excess of 90 days will normally be handled by ordnance maintenance personnel only.

(3) Immediately upon receipt of vehicles for storage, they must be inspected and serviced as prescribed in paragraphs 7 through 10. Perform a systematic inspection and replace or repair all missing or broken parts. If repairs are beyond the scope of the unit, and vehicle will be inactivated for an appreciable length of time, store them in a limited storage status and attach tags specifying repairs needed. Reports of these conditions will be submitted by the unit commander for action by an ordnance maintenance unit.

c. Inspections During Storage. Perform a visual inspection periodically to determine general condition. If corrosion is found on any part, remove the rust spots, clean, paint, and treat with the prescribed preservatives.

Note.—Touch-up painting will be in accordance with TM 9–2851.

d. Removal From Limited Storage.

(1) If vehicles are not shipped or issued upon expiration of the limited storage period, they may either be processed for an-

other limited storage period or be further treated for stand-by storage (vehicles inactivated for periods in excess of 90 days up to 3 years) by ordnance maintenance personnel.

(2) If vehicles to be shipped will reach their destination within the scope of the limited storage period, they need not be processed upon removal from storage unless inspection reveals it to be necessary according to anticipated in-transit weather conditions.

Note.—All vehicles being reissued through the depot supply system to troops within the continental limits of the United States must meet the requirements of TB ORD 385. This is not required for so-called reissues, exchanges, or redistribution among troop units, where the depot supply system is not involved.

(3) Deprocess vehicles when it has been ascertained that they are to be placed into immediate service. Remove all rust-preventive compounds and thoroughly lubricate as prescribed in paragraphs 53 through 59. Inspect and service vehicles as prescribed in paragraphs 7 through 10.

(4) Repair and/or replace all items tagged in accordance with *b*(3) above.

e. Storage Site. The preferred type of storage for vehicles is under cover in open sheds or warehouses whenever possible. Where it is found necessary to store vehicles outdoors, the storage site must be selected in accordance with AR 700–105, and vehicle protected against the elements as prescribed in TB ORD 379.

228. Loading the ¼-Ton 4 x 4 Utility Truck M38A1 for Rail Shipment

a. Preparation.

(1) When vehicles are shipped by rail, every precaution must be taken to see that they are properly loaded and securely fastened and blocked to floor of flatcar. All on vehicle matériel (OVM) will be thoroughly cleaned, preserved, packed (boxed or crated), and securely stowed in or on vehicle or on flatcar for transit.

(2) Prepare all vehicles for rail shipment in accordance with paragraph 226. In addition, take the following precautions:

(*a*) If vehicle is to be shipped within the continental United States, except directly to ports of embarkation, disconnect the battery cables from battery. Clean if necessary and wrap cable terminals and battery posts with nonhygroscopic adhesive tape. Secure terminals away from battery.

Note.—Not required for drive-away movement.

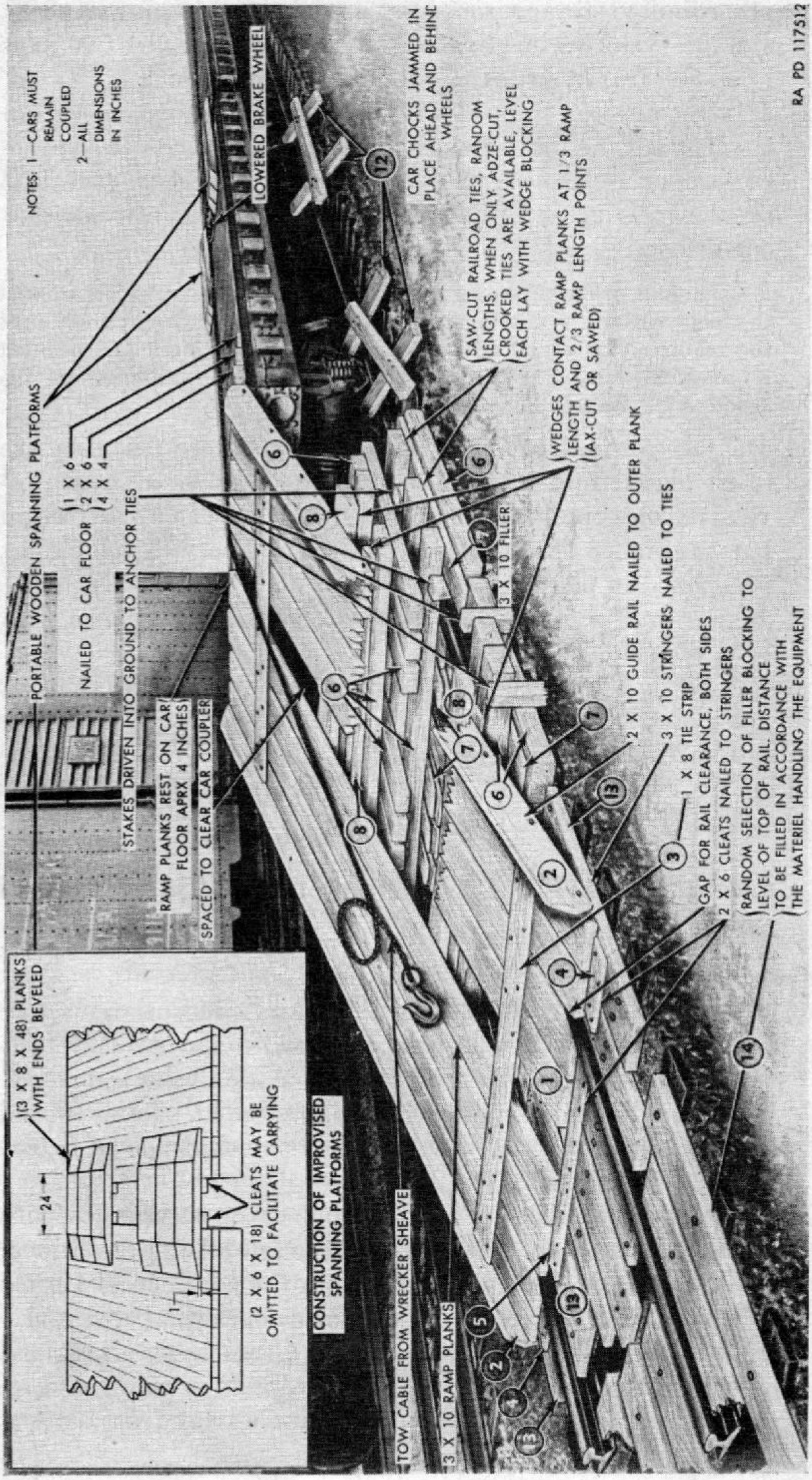

Figure 127. Construction of improvised loading ramp and spanning platforms.

BILL OF MATERIALS FOR RAMP AS ILLUSTRATED					
PART NO	QUANT REQ'D	PART NAME	LENGTH	WIDTH	THICKNESS
1	8	RAMP PLANKS	20 ft	10 in	3 in
2	2	GUIDE RAILS	20 ft	8 in	2 in
3	2	TIE STRIPS	8 ft	8 in	1 in
4	2	CLEATS	18 in	6 in	2 in
5	1	CLEAT	56 in	6 in	2 in
6	31	RAILROAD TIES	8 ft	8 in	8 in
7	AS REQD	FILLERS	AS REQD	10 in	3 in
8	AS REQD	WEDGES (CUT TO FIT)	8 ft	—	—
9	1	STEPDOWN PIECE	8 ft	4 in	4 in
10	1	STEPDOWN PIECE	8 ft	6 in	2 in
11	1	STEPDOWN PIECE	8 ft	6 in	1 in
12	4	CHOCK BLOCKS	AS REQD	4 in	4 in
13	AS REQD	STRINGERS	AS REQD	10 in	3 in
14	AS REQD	GROUND DUNNAGE	AS REQD		

NOTES:

1 RAMP SHOWN IS OF CAPACITY OF LARGEST END-LOADING FREIGHT CAR. FOR LESSER LOADS, REDUCE NUMBER OF RAMP PLANKS.

2 WIDTH DETERMINED BY TREAD OF MATERIEL BEING LOADED.

3 FOR LOADING TWO WHEELED ARTILLERY TRAILERS, OR SHORT WHEELBASE MATERIEL, RAMP PLANKS MAY BE SHORTER.

CAUTION: WHEN RAMP IS TOO SHORT, UNDERPINNING OF MATERIEL WILL STRIKE END OF RAMP (EX: 90 MM AA GUN).

4 OPENING AT CENTER MAY BE FILLED UP TO THE CAR COUPLER TO AVOID INJURY TO MANEUVERING PERSONNEL.

5 FOR LOADS OVER 40-TONS, APPROACH END OF FLATCAR MUST BE BLOCKED UP TO AVOID TIPPING OF FLATCAR.

6 THIS TYPE RAMP IS ADAPTABLE TO DROP-END GONDOLA AND AUTO END-DOOR BOX CAR LOADING.

7 WHEN LOADING AN AUTO END-DOOR BOX CAR, IT MAY BE NECESSARY TO LOAD A FLATCAR COUPLED TO THE BOX CAR, TO GAIN OVERHEAD LOADING CLEARANCE.

8 WHEN LOADING BY WRECKER CABLE, WITH PULL AT 90-DEGREES TO TRAIN, USING A SHEAVE, FLATCAR AT POINT OF PULL MUST BE LASHED TO ADJACENT RAILS, CARS, OR OTHER FIXED OBJECT.

RA PD 117513

Figure 128. Bill of materials for improvised loading ramp.

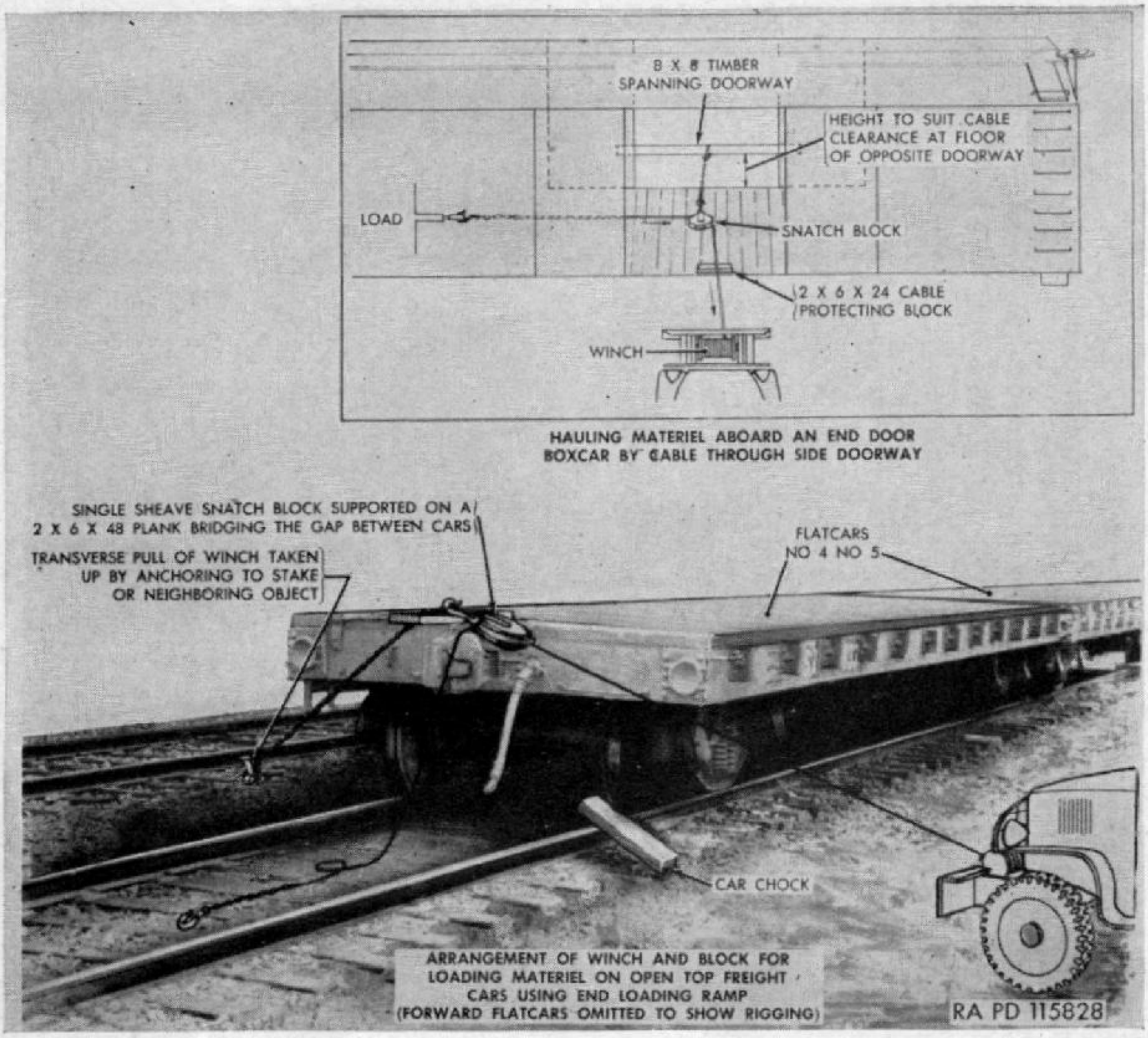

Figure 129. Method of powering the towing cable.

(*b*) If vehicle is to be shipped directly to ports of embarkation, *except* when vehicle is to be combat loaded, remove batteries, plug vents, and clean with an alkali-type cleaning compound or a solution of trisodium-phosphate diluted with water. Rinse with *cool* water and remove vent plugs. Scrape or wire brush and clean cable terminals and battery box (holder) with the above cleaning solution. Rinse with *cool* water. Coat cable terminals with automotive and artillery grease (GAA). Paint battery boxes with black acid resisting paint. Batteries will be shipped boxed in accordance with TM 9–2857 and secured in vehicle with OVM.

(*c*) Apply parking brakes and place transmission in neutral position after vehicle has been finally spotted on flatcar. Vehicle must be loaded on flatcar in such a manner as to prevent the flatcar from carrying an unbalanced load.

(*d*) If vehicle is equipped with steel tool boxes, all padlocks and keys will be removed from vehicle in order to prevent pilferage while in transit. Lids of steel tool boxes will be secured by wiring the hasp to prevent damage during shipment. Padlocks and keys will be preserved with preservative engine oil (grade I) and wrapped in greaseproof barrier-material for domestic shipment. For oversea shipment they will be sealed in a waterproof-greaseproof wrapping or bag. Locate all wrapped padlocks and keys in the accessory shipping container.

b. Types of Cars. Instructions contained herein pertain to the loading of vehicles in boxcars (cars equipped with side or side and end doors); gondola cars (an open-top car having fixed sides, fixed or drop ends and solid bottom), and flatcars (cars with wooden floors laid over sills and without sides or ends but equipped with stake pockets).

c. Method of Loading the ¼-Ton 4 x 4 Utility Truck M38A1 on Freight Cars.

(1) *Flatcar loading.*

(*a*) Vehicles will be loaded and unloaded with the use of hoisting equipment when available. When suitable hoisting equipment is not available for loading on or for subsequent unloading from a flatcar, an end ramp must be used in cases where vehicle is not on a level with the flatcar deck. Vehicles on a warehouse platform or loading dock can be pivoted over spanning platforms aboard a flatcar adjacent to the platform, then again pivoted into lateral position on flatcar.

(*b*) When unboxed vehicles must be loaded from ground level, a ramp may be improvised ((4) below) by borrowing railroad ties normally found stacked in railroad yards and by procuring necessary planking. An improvised end ramp is shown in place in figure 127. Bill of materials for constructing this ramp is shown in figure 128.

Note.—Railroad ties alone, stacked without deck planking and not securely anchored, provide a very unstable ramp and must be rearranged upon each successive use. Torque action of wheels of self-propelled vehicles will tend to collect and collapse a simple stack of railroad ties and should, therefore, not be attempted except under conditions of extreme emergency.

(*c*) Vehicles which can be loaded under their own power will be driven onto the improvised apron at base of ramp and then be carefully guided up the ramp to their positions on flatcar.

(*d*) To load vehicles which cannot be operated due to processing, tow onto the improvised apron at base of ramp and unhitch. Using a cable laid along the center line of flatcar, attached to vehicle, vehicle is pivoted to point towards ramp.

Caution.—Follow-up forward movement of vehicle by chocking behind wheels on the ramp. In chocking behind wheels, use chock block "B" shown in figure 131. Nail a 2 x 6 x 24 cleat to the top of block at an angle of 90°. A chock block of this type will enable personnel handling it to remain clear of the vehicle, thereby avoiding possible injury in the event vehicle should slip down the ramp.

(*e*) After the first vehicle is loaded on flatcar, additional vehicles or other matériel may be similarly hauled aboard by passing the towing cable beneath the loaded vehicle. When a train of flatcars is being loaded, steel or wooded spanning platforms or bridges are used to cover the gap between cars. Flatcar brake wheels must first be lowered to floor level to permit passage. A pair of improvised spanning platforms are shown in the insert in figure 127.

(*f*) The above method of train loading requires careful advance planning as to the order of loading, so that vehicles are arranged on each flatcar under prescribed methods and combinations.

(*g*) For powering the towing cable, a vehicle with winch is spotted at *right angles* to the train. It is located at about the third or fourth flatcar to facilitate signaling and because of cable length limits. A single-sheave snatch block located between cars on the train center line will provide the necessary *lateral* pull. A vehicle passing this point can be towed by a vehicle on the ground with personnel guiding its passage. A long tow cable from the towing vehicle will lessen the tendency of the towed vehicle to stray from the center line of train. As an alternate method, the use of two-towing vehicles may be used, one on each side of flatcar.

Note.—Snatch block fastening chain must be lashed to an adjacent solidly fixed object or stake to offset the cross pull of the powered winch (fig. 129).

(2) *Gondola car loading.*

(*a*) Fixed-end gondola cars may only be loaded when hoisting facilities are available for initial loading and for unloading at destination. Hopper- or drop-bottom gondola cars without false flooring and hoisting facilities are not to be used for the shipment of unboxed vehicles.

(*b*) Drop-end gondola cars may be loaded exactly as described for flatcars ((1) above). Height of fixed sides is immaterial. Vehicles may progress through a gondola car by passing over the two inwardly-dropped ends and over spanning platforms. Vehicles selected to remain in a gondola car are first moved to the *closed* end of the car, then spread out for blocking after the remaining end is closed and latched.

Note.—Do not block vehicle flush against ends of gondola cars. When ordering gondola cars, specify inside width required as some may be received with gussets along the inner sides which effect clearance.

(3) *Boxcar loading.*

(*a*) End-door boxcars are spotted with the door end toward the ramp and loaded as described for flatcars ((1) above), except, that loading must be accomplished by pushing the vehicle or towing by cable and block through the side door (fig. 129). When the height of the vehicle or other vehicles to be loaded is close to the inside height limits of the boxcar, it will be necessary to first load the vehicle on an adjacent flatcar. The two end doors must be opened before the flatcar is coupled to the door end of the boxcar.

Note.—When ordering end-door boxcars, it must be remembered that some automobile boxcars may be received with an overhead built-in rack which effects inside height calculations. Specify inside height required. Keep open end doors clear of traffic on adjacent tracks.

(*b*) Side door boxcars are provided with either single or double rolling doors at each side and must be loaded from a platform of about the same level as the boxcar floor or from an adjacent flatcar. Automobile cars of this type have large side door openings and present less difficulty in loading. However, ordinary boxcars may require the use of roller automobile jacks to maneuver the vehicle into place. Steel plates or spanning platforms must be used to bridge the gap between platform and car (fig. 127).

Note.—In emergencies when no roller jack is available, the vehicle may be moved sideways by means of an ordinary jack canted against the understructure from the floor. Wetting both the floor of the car and the bridging will reduce the friction of the tires.

(4) *Loading ramp.*

(*a*) A ramp for end-loading of vehicles on open-top freight cars may be improvised when no permanent ramps or hoisting facilities are available. A ramp suitable for loading of most ordnance items is shown in figure 127. For loading the 8-inch howitzer motor carriage M43, the width of ramp may be reduced to two double-plank runways, each cleated together. Length of planking must be determined with consideration to underhull clearance, in order to clear the hump at upper end of ramp.

Caution.—Personnel guiding vehicle up the ramp must exercise care when working close to the edges of the ramp planking.

(*b*) The flatcar bearing the ramp must be securely blocked against rolling, particularly when car brakes are not applied as in train loading. Successive cars must remain coupled and be additionally chocked at several points along the train when ground towing of vehicles aboard the train is being effected.

(*c*) Whenever flatcars are not on an isolated track or blocked siding, each end approach to the train must be posted with a blue flag or light to advise that men are at work and that the siding may not be entered beyond those points.

(*d*) Upon completion of the loading operation, ramp planks and bridging devices should be loaded on the train for use in unloading operations. Random sizes of timbers used in building the approach apron up to rail level should be included. All materials should be securely fastened to car floors, after vehicles are blocked in place, and entered upon the bill of lading (B/L). Railroad ties borrowed for the operation should not be forwarded to the unloading point unless specifically required and only with the consent of the owner.

d. Loading Rules. For general loading rules pertaining to rail shipment of ordnance vehicles, refer to TB 9–OSSC–G.

Warning.—Height and width of vehicles when prepared for rail transportation must not exceed the limitations indicated by the loading table as prescribed in AR 700–105. Whenever possible, local transportation officers must be consulted about the limitations of the particular railroad lines to be used for the movement to avoid delays, danger, or damage to equipment.

229. Blocking the ¼-Ton 4 x 4 Utility Truck M38A1 for Rail Shipment

a. General. All blocking instructions specified herein are minimum and are in accordance with the Association of American Railroads

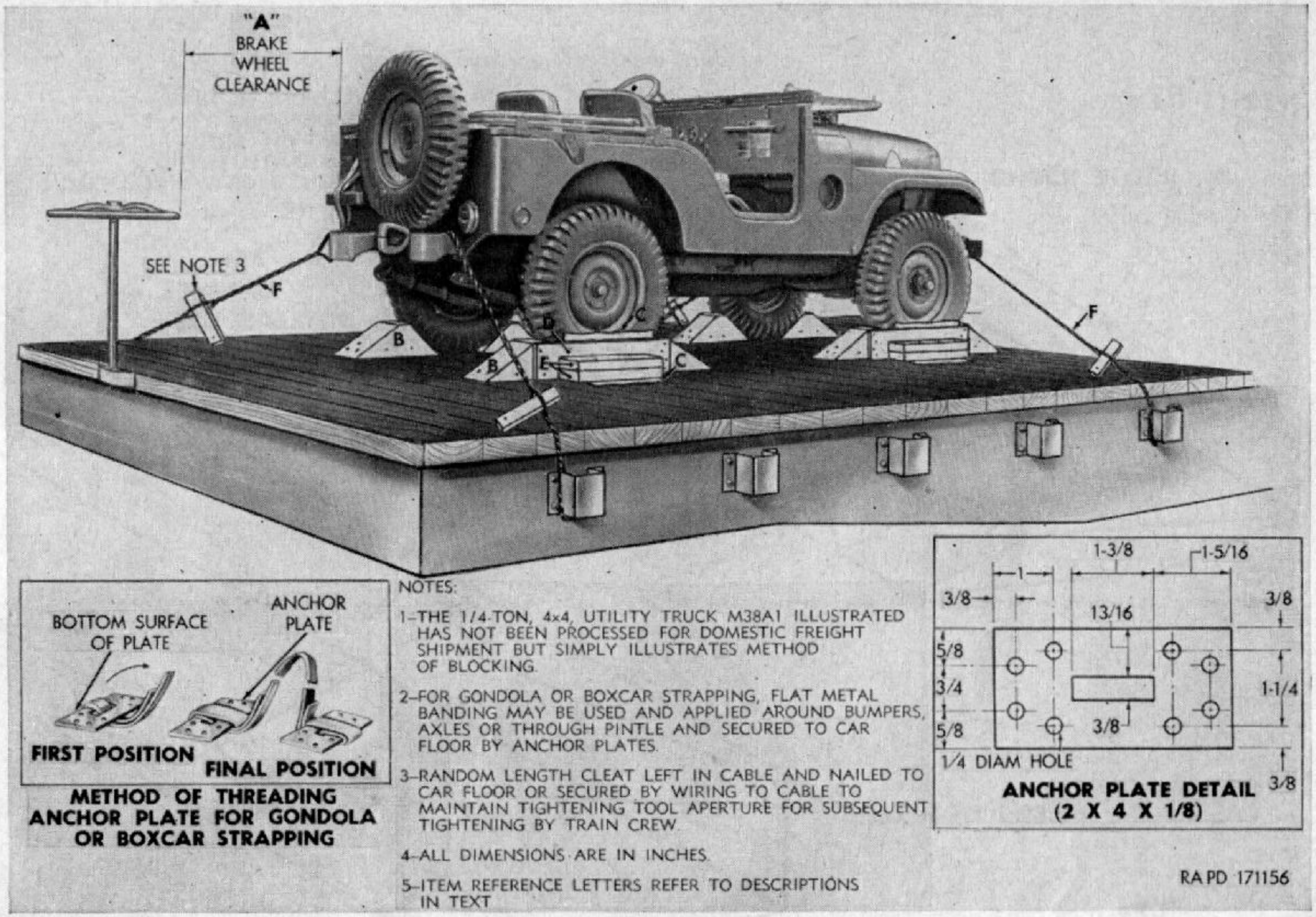

Figure 130. Method of blocking the ¼-ton 4 x 4 utility truck M38A1 for rail shipment.

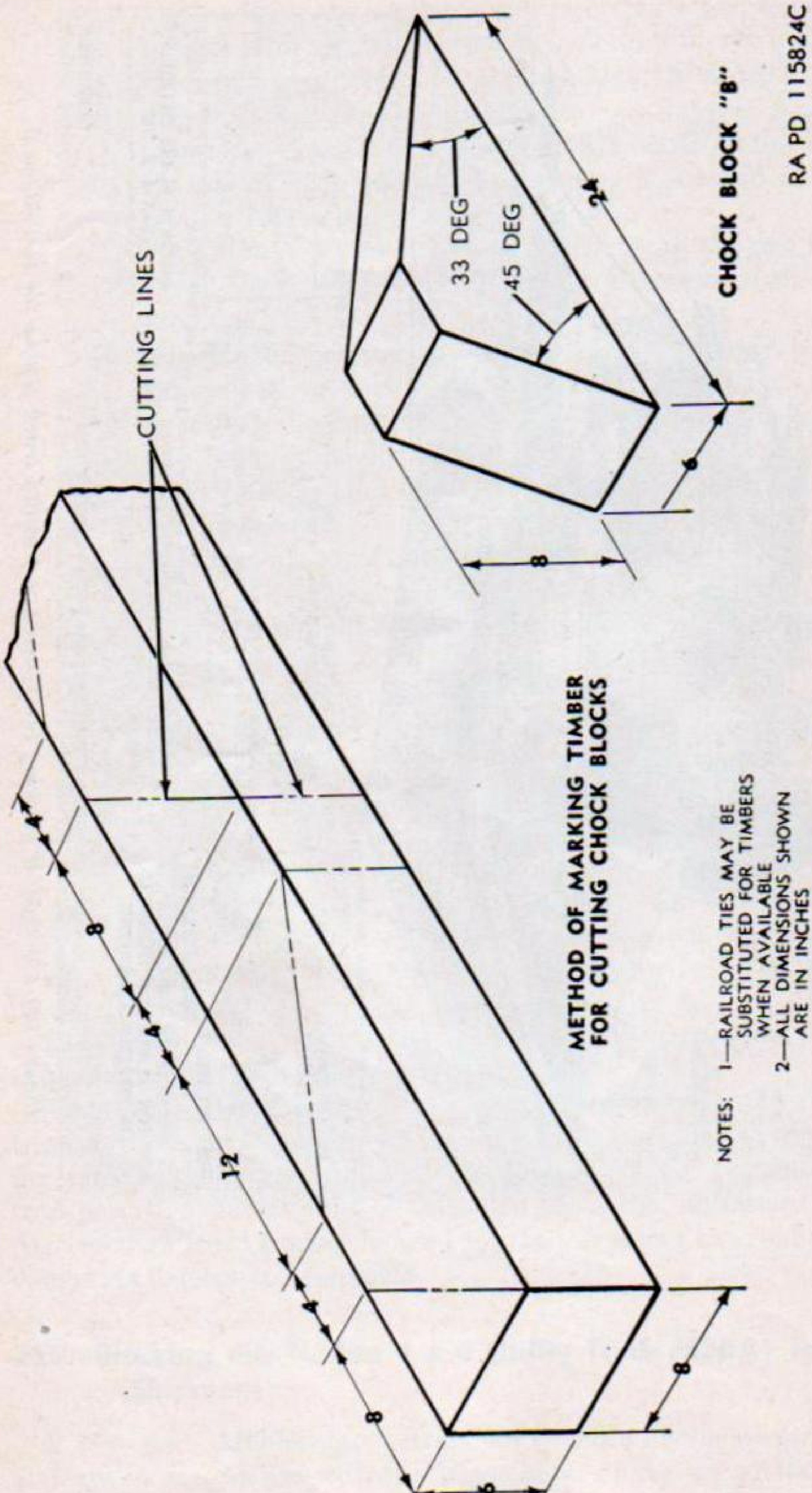

Figure 131. Cutting chock blocks from timbers.

"Rules Governing the Loading of Commodities on Open Top Cars." Additional blocking may be added as required at the discretion of the officer in charge. Double-headed nails may be used if available, except in the lower piece of two-piece cleats. Refer to TB 9–OSSC–G for methods of double loading the 1/4-ton 4 x 4 trucks on railroad flatcars. All item reference letters given below refer to the details and locations as shown in figure 130.

Note.—Any loading methods or instructions developed by any source which appear in conflict with this publication or existing loading rules of the carriers, must be submitted to the Chief of Ordnance, Washington 25, D. C., for approval.

b. Brake Wheel Clearance "A." Load vehicles on cars with a minimum clearance of at least 4 inches below and 6 inches above, behind, and to each side of the brake wheel (fig. 130). Increase clearance as much as is consistent with proper location of load.

c. Chock Blocks "B" (6 x 8 x 24, Eight Required). Locate the 45° face of blocks against the front and rear of each wheel. Blocks are to be positioned in such a manner as to allow flush application of wheel side cleats "D" (*e* below) when nailed to chock blocks. Nail heel of blocks to car floor with three fortypenny nails and toenail sides of blocks to car floor with two fortypenny nails each.

Note.—Filler cleats may be used between chock blocks and side cleats to centrally locate the chock block against tires. These cleats are not shown in figure 130. Chock blocks may be cut from timber (or railroad ties when available) as shown in figure 131.

d. Cushioning Material "C." Locate suitable cushioning material such as waterproof paper or burlap between tires and cleats "D." The cushioning material must protrude beyond cleats "E" at floor and above cleats "D."

e. Wheel Side Cleats "D" (1 x 8, Length to Suit, Four Required). Locate and nail cleats to chock blocks "B" with tenpenny nails at each end (see note in *c* above).

f. Floor Side Cleats "E" (2 x 4, Length to Suit, Eight Required). Locate two floor side cleats against each wheel and side cleat "D" with cushioning material protruding underneath cleats. Nail lower cleats to car floor with thirtypenny nails, staggered and upper cleats to lower cleats and car floor with fortypenny nails, staggered.

g. Flatcar Strapping "F" (No. 8 Gage Black Annealed Wire or Wires of Equivalent Strength).

(1) Cut four lengths of wire to length required according to the location of stake pockets. Twist-tie these wires together to form a single cable. Pass the cable over and around front bumper for a length beyond half the distance to stake pocket. Pass the other end of cable through a stake pocket forward of vehicle and form a 6-inch loop in end, winding *each* of

the four wires *tightly* around the cable a few turns. Make certain the loop is positioned well above the free end of cable. Pass the free end of cable through this loop, hand-tight, and again wind end of each wire around cable *tightly*. Locate a random length cleat in cable and insert end of a tightening tool at approximate center of strapping. Twist-tie just taut enough to remove all slack. Random length cleat should be left in cable for subsequent tightening by train crew.

(2) Repeat above operations for each corner of the vehicle.

Note.—During transit, strapping will be checked and tightened, if necessary, by train personnel.

h. Gondola or Boxcar Strapping. Apply strapping in a similar fashion as prescribed in *g* above and attach to car floor by twisting wire around wooden cleats nailed to car floor. As an alternate method, substitute flat metal banding either around the bumpers or axles and secure to floor of car by use of anchor plates, see insert in figure 130.

Section II. DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

230. General

a. Destruction of the 1/4-ton 4 x 4 utility truck M38A1 when subject to capture of abandoment in the combat zone, will be undertaken by the using arm only when, in the judgment of the unit commander concerned, such action is necessary in accordance with orders of, or policy established by, the army commander.

b. The information which follows is for guidance only. Certain of the procedures outlined require the use of explosives and incendiary grenades which normally may not be authorized items for the vehicle. The issue of these and related materials, and the conditions under which destruction will be affected, are command decisions in each case, according to the tactical situation. Of the several means of destruction, those most generally applicable are:

Mechanical—Requires axe, pick, mattock, sledge, crowbar, or similar implement.

Burning —Requires gasoline, oil, incendiary grenades, or other inflammables.

Demolition—Requires suitable explosives or ammunition.

Gunfire —Includes artillery, machine guns, rifles using rifle grenades, and launchers using antitank rockets. Under some circumstances hand grenades may be used.

In general, destruction of essential parts, followed by burning will usually be sufficient to render the truck useless. However, selection of the particular method of destruction requires imagination and resourcefulness in the utilization of the facilities at hand under the existing conditions. Time is usually critical.

c. If destruction to prevent enemy use is resorted to, the truck must be so badly damaged that it cannot be restored to a usable condition in the combat zone either by repair or cannibalization. Adequate destruction requires that all parts essential to the operation of the matériel, including essential spare parts, be destroyed or damaged beyond repair. However, when lack of time and personnel prevents destruction of all parts, priority is given to the destruction of those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all like matériel so that the enemy cannot construct one complete unit from several damaged ones.

d. If destruction is directed, due consideration should be given to:

(1) Selection of a point of destruction that will cause greatest obstruction to enemy movement and also prevent hazard to friendly troops from fragments or ricocheting projectiles which may occur incidental to the destruction.

(2) Observance of appropriate safety precautions.

231. Method No 1—Destruction by Burning

a. Remove and empty portable fire extinguishers.

b. Puncture the fuel tank as near the bottom as possible, collecting gasoline for use as outlined in *f* below.

c. Using an axe, pick mattock, sledge, or other heavy implement, smash all vital elements such as distributor, carburetor, generator, ignition coil, fuel pump, spark plugs, air cleaner, lights, instruments, and controls. If time permits, and sufficiently heavy implement is available, smash the engine cylinder block and cylinder head, crankcase, and transmission.

d. Slash tires. If tires are inflated, exercise care to prevent injury should the tire blow out while being slashed. Whenever practicable, it is usually preferable to deflate tires before slashing.

e. Explosive ammunition, if present in the vehicle or available nearby, should be removed from packing or other protective material. Place ammunition in and about the vehicle so that it will be fully exposed to the fire and in such locations that the greatest damage will result from its detonation. Remove any safety devices from ammunition.

f. Pour gasoline and oil in and over the entire vehicle. Ignite and take cover. If gasoline and oil are not available, use incendiary grenades.

Caution.—Cover must be taken without delay since an early explosion of the explosive ammunition may be caused by the fire. Due consideration should be given to the highly inflammable nature of gasoline and its vapor. Carelessness in its use may result in painful burns.

Elapsed time: about 6 minutes.

232. Method No 2—Destruction By Demolition

a. Remove and empty portable fire extinguishers.

b. Puncture fuel tank.

c. Prepare two 2-pound charges of EXPLOSIVE, TNT (two 1-lb blocks or equivalent per charge together with the necessary detonating cord). Set the charges as follows:

(1) *One* on *top* of the clutch housing.

(2) The *second*, as low on the left side of the engine as possible.

(3) Connect the *two* charges for simultaneous detonation with detonating cord. Provide for dual priming to minimize the possibility of a misfire.

(4) For priming either a nonelectric blasting cap crimped to at least 5 feet of safety fuse (safety fuse burns at a rate of one foot in 30 to 45 seconds; test before using) or an electric blasting cap and firing wire may be used. If a nonelectric blasting cap and safety fuse are used, the fuse should be sufficiently long and so positioned that it may be ignited from the outside of the vehicle since gasoline, which is draining from the fuel tank, may be exploded by the burning fuse. Safety fuse, which contains black powder, and blasting caps must be protected from moisture at all times. The safety fuse may be lighted by a fuse lighter or a match; the electric blasting cap requires a blasting machine or equivalent source of electricity.

Caution.—Keep the blasting caps, detonating cord, and safety fuse separated from the charges until required for use.

Note.—For the successful execution of methods of destruction involving the use of demolition materials, all personnel concerned will be thoroughly familiar with the provisions of FM 5-25. Training and careful planning are essential.

d. Destroy the tires by placing an incendiary grenade under each tire exercising care to prevent early ignition of gasoline or its vapor by the burning grenades. The detonation of the explosive charges should be delayed until the fires are well started. This will prevent the fires from being extinguished by the blast when the charges are detonated.

e. Detonate the cha
and safety fuse, ignite
ing cap, take cover bef

Caution.—Cover m
plosion of the charges

Elapsed time: about 6

233. Method No. 3

a. Remove and emp

b. Puncture fuel ta

c. Destroy the tires

d. Destroy the vehi
using rifle grenades,
the vehicle aiming a
well placed direct hit
required for complet
which case the vehicl

Caution.—Firing
cover.

Elapsed time: about

216221°—52——19

e. Detonate the charges. If primed with nonelectric blasting cap and safety fuse, ignite and take cover. If primed with electric blasting cap, take cover before firing the charges.

Caution.—Cover must be taken without delay since an early explosion of the charges may be caused by the incendiary fires.

Elapsed time: about 6 minutes.

233. Method No. 3—Destruction By Gunfire

a. Remove and empty portable fire extinguishers.

b. Puncture fuel tanks.

c. Destroy the tires as in paragraphs 231*d* or 232*d*.

d. Destroy the vehicle by gunfire using artillery machine guns, rifles using rifle grenades, or launchers using antitank rockets. Fire on the vehicle aiming at the engine, axles, and wheels. Although one well placed direct hit may destroy the vehicle, several hits are usually required for complete destruction unless an intense fire is started, in which case the vehicle may be considered destroyed.

Caution.—Firing at ranges of 500 yards or less should be from cover.

Elapsed time: about 6 minutes.

APPENDIX
REFERENCES

1. Publication Indexes

The following publication indexes and lists of current issue should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to matériel covered in this manual:

Index of Administrative Publications	SR 310-20-5
Index of Army Motion Pictures, Kinescope Recordings and Film Strips.	SR 110-1-1
Index of Blank Forms and Army Personnel Classification Tests.	SR 310-20-6
Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.	SR 310-20-4
Index of Training Publications	SR 310-20-3
Introduction and Index (supply catalogs)	ORD 1
Military Training Aids	FM 21-8
Ordnance Major Items and Major Combinations and Pertinent Publications.	SB 9-1

2. Supply Catalogs

The following catalogs of the Department of the Army Supply Catalog pertain to this matériel:

a. Destruction to Prevent Enemy Use.

Land Mines and Fuzes, Demolition Material, and Ammunition for simulated Artillery and Grenade Fire.	ORD 11 SNL R-7

b. Repair and Rebuild.

Antifriction Bearings and Related Items	ORD 5 SNL H-12
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.	ORD 3 SNL K-1
Electrical Fittings	ORD 5 SNL H-4

Items of Soldering,
and Welding Mat
lated Items.
Lubricating Equipm
Related Dispense
Lubricating Fitting
Filter Elements.
Major Items and M
Group G.
Miscellaneous Hard
Oil Seals
Pipe and Hose Fitti
Standard Hardware
c. Vehicle.
Truck, ¼-Ton, 4 x

3. Forms

The following forms p
WD AGO Form 9-
DA AGO Form 9-3
of Vehicles and I
WD AGO Form 9
(Card).
DA Form 9-68, Sp
Half-Track Vehi
DA Form 460, Pre
DA Form 461, Pr
for Wheeled and
DA Form 461-5, L
DA Form 468, Un
DA Form 478, M
Record and Org
DA Form 811, Wo
DA Form 811-1, V
DD Form 6, Repo
DD Form 313, U.
DD Form 317, Pr

4. Other Publication

The following expla
tinent to this matériel
a. Camouflage.
Camouflage, Basic
Camouflage of Vel

*See ORD 1 for published catalo

Items of Soldering, Metallizing, Brazing and Welding Materials: Gases and Related Items.	ORD 3 SNL K–2
Lubricating Equipment, Accessories, and Related Dispensers.	ORD (*) SNL K–3
Lubricating Fittings, Oil Filters, and Oil Filter Elements.	ORD 5 SNL H–16
Major Items and Major Combinations of Group G.	ORD 3 SNL G–1
Miscellaneous Hardware	ORD 5 SNL H–2
Oil Seals	ORD 5 SNL H–13
Pipe and Hose Fittings	ORD 5 SNL H–6
Standard Hardware	ORD 5 SNL H–1

c. Vehicle.

Truck, ¼-Ton, 4 x 4, Utility, M38A1	ORD(*) SNL G–758

3. Forms

The following forms pertain to this matériel:

WD AGO Form 9–1, Material Inspection Tag.
DA AGO Form 9–3, Processing Record for Shipment and Storage of Vehicles and Boxed Engines.
WD AGO Form 9–4, Vehicular Storage and Servicing Record (Card).
DA Form 9–68, Spot Check Inspection Report for Wheeled and Half-Track Vehicles.
DA Form 460, Preventive Maintenance Roster.
DA Form 461, Preventive Maintenance Service and Inspection for Wheeled and Half-Track Vehicles.
DA Form 461–5, Limited Technical Inspection.
DA Form 468, Unsatisfactory Equipment Report.
DA Form 478, MWO and Major Unit Assembly Replacement Record and Organizational Equipment File.
DA Form 811, Work Request and Job Order.
DA Form 811–1, Work Request and Hand Receipt.
DD Form 6, Report of Damaged or Improper Shipment.
DD Form 313, U. S. Government Operator's Permit.
DD Form 317, Preventive Maintenance Service Due (Sticker).

4. Other Publications

The following explanatory publications contain information pertinent to this matériel and associated equipment:

a. Camouflage.

Camouflage, Basic Principles	FM 5–20
Camouflage of Vehicles	FM 5–20B

*See ORD 1 for published catalogs of the ordnance section.

b. Decontamination.

Decontamination	TM 3–220
Decontamination of Armored Force Vehicles.	FM 17–59
Defense Against Chemical Attack	FM 21–40

c. Destruction to Prevent Enemy Use.

Explosives and Demolitions	FM 5–25
Ordnance Service in the Field	FM 9–5

d. General.

Cooling Systems: Vehicles and Powered Ground Equipment.	TM 9–2858
Precautions in Handling Gasoline	AR 850–20
Preparation of Ordnance Matériel for Deep-Water Fording.	TM 9–2853
Prevention of Motor Vehicle Accidents	SR 385–155–1
Principles of Automotive Vehicles	TM 9–2700
Report of Accident Experience	SR 385–10–40
Storage Batteries, Lead-Acid Type	TM 9–2857
Supplies and Equipment: Motor Vehicles	AR 700–105
Supplies and Equipment: Unsatisfactory Equipment Report.	SR 700–45–5

e. Repair and Rebuild.

Abrasives, Cleaning, Preserving, Sealing, Adhesive, and Related Materials Issued for Ordnance Matériel.	TM 9–850
Disposal of Supplies and Equipment: Uneconomically Repairable Ordnance Vehicles.	SR 755–105–5
Hand, Measuring, and Power Tools	TM 10–590
Information and Repair Instructions	TB ORD 111
Instruction Guide: Care and Maintenance of Ball and Roller Bearings.	TM 37–265
Lubrication	TM 9–2835
Maintenance and Care of Hand Tools	TM 9–867
Maintenance and Care of Pneumatic Tires and Rubber Treads.	TM 31–200
Maintenance of Supplies and Equipment: Maintenance Responsibility and Shop Operation.	AR 750–5
Modification of Ordnance Matériel	SB 9–38
Ordnance Maintenance: Carburetors (Carter).	TM 9–1826A
Ordnance Maintenance: Electrical Equipment (Auto-Lite).	TM 9–1825B

Ordnance Maintenance: Fuel Pumps	TM 9–1828A
Ordnance Maintenance: Hydraulic Brakes (Wagner-Lockheed).	TM 9–1827C
Ordnance Maintenance: Speedometers, Tachometers, and Recorders.	TM 9–1829A
Ordnance Maintenance: Vehicular Equipment, Grinding, Boring, Valve Reseating Machines, and Lathes.	TM 9–1834A
Painting Instructions for Field Use	TM 9–2851
Preventive Maintenance of Electric Motors and Generators.	TM 55–405

f. Shipment and Stand-By or Long-Term Storage.

Army Shipping Document	TM 38–705
Instruction Guide: Ordnance Packaging and Shipping (Posts, Camps, and Stations).	TM 9–2854
Marking and Packaging of Supplies and Equipment: Marking of Oversea Supply.	SR 746–30–5
Military Standard—Marking of Shipments.	MIL–STD–129 [1]
Ordnance Storage and Shipment Chart—Group G	TB 9–OSSC–G
Preparation of Unboxed Ordnance Matériel for Shipment.	SB 9–4
Preservation, Packaging, and Packing of Military Supplies and Equipment.	TM 38–230
Protection of Ordnance General Supplies in Open Storage.	TB ORD 379
Shipment of Supplies and Equipment: Report of Damaged or Improper Shipment.	SR 745–45–5
Standards for Oversea Shipment and Domestic Issue of Ordnance Matériel Other Than Ammunition and Army Aircraft.	TB ORD 385
Storage, Inspection, and Issue of Unboxed Serviceable Vehicles; Preparation of Unserviceable Vehicles for Storage and Deprocessing of Matériel Prior to Operation.	SB 9–63

[1] Copies may be obtained from Aberdeen Proving Ground, Aberdeen, Md.

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